Oak Forest Elementary

2022 – 2023

Fifth Grade Science and Math Gardening Manual

Harvesting Knowledge, Cooperation, and Produce

The Deborah Krenek 5th Grade Teaching Garden

Garden 2003

Little Red Shed

The Sanders Outdoor Classroom

Monarch Watch Beds

Annex Garden

Orchard

Student's Name: _____ **Team Number:** _____

Science Teacher: _____

The OFE Growers Organization

This manual is provided by OFE Growers, Inc., an independent, all-volunteer, non-profit 501-c-3 corporation. The pages in this manual have been developed by OFE volunteers over the past 20 years as a written guide for the 5th grade math, science, and gardening classes. It is used by students during their gardening classes. Each student gardens once every two weeks. Students are encouraged to read the pages, answer questions, and write notes in this booklet. At the end of the school year, it is theirs to take home. In the past, many families have used its information to start a home garden.

Funding for and contributions to the science and gardening programs are administered by a non-profit corporation, OFE Growers, Inc. Donations to this non-profit organization are tax deductible to the full extent of the law. Your support, financially and physically, is needed to continue the program. Contributions can be made to OFE Growers, PO Box 5125, Kingwood, TX 77325. If you have a small business, please consider adding OFE Growers to your list of year-end donations. Individuals can do the same.
Checks should be made payable to "OFE Growers".

The largest expenditure of OFE Growers is the continuing operation of the fifth-grade gardens and the weekly gardening classes with the students. Tools, gloves, supplies, plants, seeds, fertilizers, mulch, student manuals, and many other items are expensive. The students grow everything organically and recycle countless trash bags of green waste each year into compost or mulch. They grew close to 3,000 pounds of produce last year. During the school year, almost all produce goes home with students at no cost to them.

ExxonMobil is a major funding source for the program through the **V**olunteer **I**nvolvement **P**rogram (**VIP.**) By volunteering time at Oak Forest, current employees, their spouses, and retirees can access ExxonMobil grants to support OFE Growers. If you qualify, we need your help. Contact Hal Opperman: (see e-mail address below)

Postnet 194 in Kingwood has generously discounted their prices for our printing needs including this gardening manual. This is a local business which has rebuilt after the Harvey flood and deserves our support.

Please consider supporting the work of OFE Growers with your time, money, or material donations.

Each fall the Growers offer canned preserves made by the volunteers from fruits and vegetables from the summer gardens. Your donations for these jams, jellies, and other preserves are a major funding source for this program.

Parents, community members, and business partners can learn more by attending OFE Growers' board meetings or e-mailing specific questions to **Hal@keepkingwoodgreen.org**. You may keep up with weekly garden news by going to the school website and then to the Growers' page, or directly to the Growers' website at: www.**OFEGrowers.org**.

The Founders of the 5th Grade Gardening Program

Mrs. Deborah Krenek had a vision in 2002 of a "hands-on-garden" where students could learn by doing. She envisioned the students being able to experiment, measure, and work math problems with real, instead of theoretical problems. She was the lead 5th grade math and science teacher and the president of the organization until her retirement. The main garden is named in her honor as the "**Deborah Krenek Teaching Garden".**

Mrs. Jo Sanders started the gardens at OFE in 2002 and was its first volunteer gardener. Mrs. Sanders is a retired high school math teacher and a Texas Master Gardener. She has served on the Growers board as secretary until her retirement in 2020. Her late husband Mr. Ken Sanders built the Little Red Shed, its potting benches, and benches in the orchard. The Outdoor Classroom is named in their honor for all the contributions both have made to the gardening program at OFE.

The OFE Growers Volunteers

The gardening program at OFE is a success thanks to the volunteers who have donated their time and resources, as well as several businesses that have contributed greatly over the years. Without the help of the teachers, volunteers, and others who assist with workdays or special projects, none of the gardening classes or natural enhancements to the campus would be possible. Thank you all for your commitment to this program!

Officers of the OFE Growers are as follow:

Mrs. Lisa Marucci is the President of the Growers. She currently teaches 5th grade math and science.
Mr. Eric Vogel serves as the Administrative Vice President and Treasurer of the OFE Growers. He is a community member.
Mrs. Kristi Kreischer is the Secretary for the Growers and a community member.
Mr. Denton Langridge, a community member serves the board as Garden Operations Coordinator.
Mrs. Gudrun Opperman is the Student Garden Activities Coordinator and a community member.

Other staff members who also serve as board members include:
Mrs. Marissa Tiffin and Mrs. Andrea Harisis.

Other volunteers who work with the fifth-grade students and help maintain the gardening program at OFE are listed below. Another group of additional community members help the Growers behind the scenes and on special work projects.
(OFE Growers board members are denoted by X)

Mrs. Sue Allen	**X**
Mrs. Sondra Alliston	
Mrs. Phyllis Bost	**X**
Mrs. Judy Brown	**X**
Mrs. Denise Caruselle	
Mrs. Diane Engelhardt	
Ms. Sydney Hamilton	**X**
Mrs. Sally Koelzer	**X**
Mrs. Deborah Krenek	**X**
Mrs. MarySue Lewis	
Mrs. Leslie McCartney	
Mrs. Patti Muhlberger	**X**
Mrs. Anne Mullins	**X**
Mr. Hal Opperman	**X**
Mrs. Teresa Simmons	
Mrs. Lisa Vogl	
Mrs. Tonya Stephens Wiemers	
Mr. John Wiemers	
Mrs. Diane Wolf	**X**

Get to know your volunteers. Go to: **www.ofegrowers.org/volunteers.**

Table of Contents

Page #	
2	The OFE Growers Organization
3	The OFE Growers Officers and Volunteers
4	Table of Contents
5	Garden Orientation
6	Safety in and around the Garden
7	Good Gardening Practices
8 & 9	Composting & Compost Tea
10	Soil
11	Healthy Soil
12	Reading and Understanding Seed Packets
13	Potted Plant and Seed Planting Guide
14	Thinning Seedlings
15	Leafy Greens: Lettuce, Spinach, Swiss Chard, Arugula, and French Sorrel
16	Root Crops: Radishes and Beets
17	Root Crops: Carrots and Turnips
18	Cole Crops
19	Legumes: Peas and Beans
20	Onions and Garlic
21	Potatoes: White and Sweet Potatoes
22	Tomatoes and Tomatillos
23	Peppers and Eggplants
24	Cucumbers and Squash
25	Pumpkins and Gourds
26 & 27	Herbs
28	Okra and Cotton
29	Sugarcane
30 & 31	Pollination
32	Honeybees
33	Insect Plant Damage
34	Insects in the Garden
35	Insect Metamorphosis
36	Integrated Pest Management (IPM)
37 & 38	Butterfly Gardening
39	Fruit Growing on Campus
40	Planting a Containerized Tree
41	Harvest Celebration
42	Favorite Recipes
43	You Are What You Eat
44	Three Sisters Garden
45	Organic Products Used in the OFE Gardens
46 & 47	Rainwater Harvesting
48 - 50	Glossary
51	Resources
52	Puzzle Fun
53 - 55	Garden Layouts
56 & 57	How to Read Gauges
58	Tools to Know
59	Planting Chart for the Lake Houston Area

5th Grade Garden Orientation

Tour of the campus:

1) **Oak Forest orchard**
   a) Home to the chimney swift tower, purple martin birdhouses, feeding, and watering stations for native creatures.
   b) Fruit trees, grape vines, and native trees and shrubs
   c) Large planting beds and additional composting areas

2) **Composting area near the shed and rainwater harvesting systems**
   a) Green waste, leaves, grass, and pine needles are composted there.
   b) Three bins for composting
   c) The water harvesting tank which holds 250+ gallons.

3) **Little red shed**
   a) Storage for tools and supplies
   b) Composting sign
   c) Water catchment sign
   d) Harvest and potting bench

4) **Main garden area and herb beds around the shed**
   a) Each bed has a number on a small stake inside the bed.
   b) Most of the produce is grown there.

5) **Annex garden** (west of main garden behind brick wall)
   a) Additional planting beds
   b) Trellis bed for climbing vegetables

6) **Jo and Ken Sanders Outdoor Classroom** (In the annex under the oak tree)

7) **5th grade trees (various locations on campus)**
   a) Gift from each class to the school since 2004
   b) Trees are planted for Arbor Day in February

8) **Pollinator and Monarch Watch** beds near main and annex garden areas.
   a) Plants in these beds benefit pollinators.
   b) Informational signs pertaining to pollinators and lifecycles
   c) Monarch Watch beds are designed for the needs of monarch butterflies as per the Monarch Watch organization. Many butterflies are released at OFE each year.

9) **Nature area** along east parking lot, native and non-native tree barrier and drop off spot for leaves and pine needles from the neighborhood. (Back by water tower)

Each student will have a chance to work in many of these areas and will have helped to make Oak Forest an even more special place! It is the only school in Humble ISD that has these facilities and opportunities for “hands on” learning.

Safety in and around the Garden

Working in the garden can be lots of fun and very rewarding when we are able to harvest our produce. Since we are working closely with many other students, lots of tools and around garden beds, it is important that we follow the safety rules so that no one is hurt.

1) **Do not run in or around the garden area.**

2) **Always stay on the paths. Never step on a garden bed unless told to do so by an adult.**

3) **Do not try to jump across a garden bed.**

4) **Do not try to walk on the edges of the beds.**

5) **When carrying a tool, always point the sharp end towards the ground.**

6) **When using a tool with a long handle, make sure there is plenty room around you so that you do not hit someone with it. Only use it for its intended purpose.**

7) **Bees and wasps are a normal part of the garden. Do not panic. They will not harm you if you do not swat at them or otherwise bother them.**

8) **If you see fire ants or a snake, move away slowly and tell an adult.**

9) **Do not climb on the fences, tables, or compost bins.**

10) **Always wear appropriate clothing, including closed-toe shoes for gardening.**

11) **If you do not know how to do something, ask for help. We are all learning.**

12) **Always take tools back to the shed after you are finished with them.**

13) **Always place the sharp end of a tool down when laying it in a bed or pathway.**

14) **A pruner cuts whatever is placed between the blades. Do not let it be your finger!**

15) **Clean shoes in the grass before going inside and wash hands after gardening.**

Safety is *NO* Accident!

Let us have an accident-free year!

Safety is the responsibility of each student!

Good Gardening Practices

- **Follow all safety rules. Safety is always our highest priority!**
- **Listen carefully to directions given to you.**
- **Finish the job assigned to you or chosen by you.**
- **When you complete your job, return all tools and equipment to the shed for storage.**
- **Use all tools for their intended purpose. Remember the safety rules!**
- **Clean your tools when finished with them.**
- **Be considerate of others and help them complete their jobs.**
- **If a team member does not understand the directions given, help them understand the assignment.**
- **Be willing to teach classmates what you have learned; share your knowledge with your family.**
- **The harvest will be shared with your classmates. Each student receives an equal amount of produce, but not always the same type of produce.**
- **Treat your bag of produce gently. Some things bruise easily.**
- **Empty your bag of produce when you get home. Store produce in the refrigerator if appropriate.**
- **If you absolutely know that your family will not use some of the produce given to you, give it to a fellow classmate who would like to have it.**
- **Also, if you do not like something in your bag, trade with a student for something they will share.**

Composting

Compost is made up of decayed plant material. Compost is used as an organic mulch or fertilizer. Everything that is organic will eventually compost or decompose. Making compost in a compost heap speeds up the decomposition process. Compost can also be made by just stacking organic matter in a pile that is left alone. If you have ever moved a pile of leaves and twigs that had been in the same spot for a few years or even after a wet summer, you will find a little bit of compost at the bottom of the pile. There are lots of compost systems available. At OFE we use the three-bin system. (One at the main garden, where about one ton of compost is made per year, and one in the orchard.)

Bin 1 --- This bin is where we put all the raw materials.
Bin 2 --- We move items from bin 1 to bin 2 after they start to **decompose.** (after ~ 3 months)
Bin 3 --- This is finished compost that is or soon will be ready to use in the garden

Five ingredients are needed to build an active compost heap.

1. **Green matter** is a **nitrogen** source
2. **Brown matter** is a **carbon** source
3. **Moisture** is important
4. **Oxygen** is also necessary
5. **Microbes** break down or decompose the green and brown matter.

A microbe source may be horse or cow manure, compost from bin #3, or garden soil.

The compost heap should be an enclosure made of chicken wire or other material that has an area of 4 square feet and at least 3 feet high. It must allow air to circulate; wire is ideal. It is best to have the heap hidden but somewhat in the open. It should be sitting on soil, not stone or concrete.

Green material can be “just cut” grass, green plants, or vegetable waste matter from the kitchen or cafeteria. Weeds from the garden are also a good source of “green” matter unless they have mature seeds. To this we add and mix two parts of “brown” matter by weight. For example, if you are adding one pound of green grass, add two pounds of dried leaves or something else that is brown (pine needles, dry plants, twigs, newspapers). These items should be mixed and be in pieces cut as small as possible. Raw materials can be mulched with a lawnmower or cut into small pieces with a pruner. The bigger the material is, the longer it takes to turn into compost. By turning the pile with a shovel, pitchfork, or compost tool on a regular basis, you introduce air. Rainfall will add moisture, but if there is no rain for a few weeks you should add water. City water has chlorine in it that kills microbes so using rain water from the big green tank or buckets, well water, or stream water instead is better. To add microbes to the mix, add a few shovels of garden soil, finished compost, or a bag of cow, horse, chicken, or sheep manure. (never from a dog or cat)

Decomposition of green and brown matter is done by the billions of tiny **microbes or micro-organisms** that live and grow in the pile. As they work hard eating the matter, they generate heat, or thermal energy just as you do when you work hard. The middle of the pile can reach 150 degrees F. In addition, the pile will be home to lots of bugs, such as ants, sow bugs, pill bugs, millipedes, beetle larvae, springtails, earthworms, as well as fungi. All these organisms aid in the composting. They are called **decomposers**. A properly built pile does not smell and will not attract unwanted creatures. A smelly compost pile has not been turned enough or has gotten too wet. It might be useful to cover it if a heavy rain is predicted.

When moving the mix from one bin to the next we often add more green material to feed microbes and therefore aid in heating the mix again. After several months a well-maintained pile will be ready to use in the garden or on the lawn as mulch or fertilizer. Organic gardeners often call compost “black gold”!

Composting, continued

Compost Tea: Many gardeners use some of their compost to make compost tea. Compost tea can be made in 2 ways. The easiest and quickest method is to put your compost on some sort of a filter and then pour water through it. As with a tea bag, the water will wash many of the nutrients and microbes out of the compost. The resulting liquid is then sprayed on plants or poured around their roots. Since this liquid contains beneficial microbes, it will help enrich the soil. When this is sprayed on the plant, the leaves will absorb the nutrients. A more time consuming method of making compost tea involves soaking the compost in water for 3 or 4 days with oxygen being bubbled through the mixture. This method allows the beneficial microbes to multiply very rapidly; the resulting tea is much more beneficial than the first method.

Questions about Compost

A) What are the five most important ingredients in making compost?

1. _____
2. _____
3. _____
4. _____
5. _____

B) Why is the inside of the compost heap often warmer than the outside air? How warm might it get inside?

_____

_____

C) List four decomposers you might find in a compost heap.

1. _____
2. _____
3 _____
4 _____

D) Compost is used for the following: (circle all that are correct)

1. As a mulch 2. To control insects 3. As a fertilizer 4. To fill empty flower beds

E) Green material added to the compost pile acts as a source of carbon. True False

F) Weeds pulled from the garden should be put into bin 1. True False

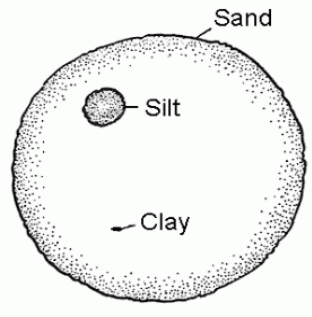
G) About how many pounds of compost do we make each year? _____

How could you estimate this amount? _____

H) Why do organic gardeners often call compost “black gold”? _____

Soil

Rock is the parent material of soil. Exposed rock is broken down, or weathered by the action of rain and wind (**weather**) into ever smaller particles. When these particles mix with dead plant and animal matter (**organic material**), the mixture becomes soil. Soil also contains millions of organisms that we cannot see (**microorganisms**) and some that we can see like earthworms, grubs, and pill bugs (**macro organisms**). These organisms (**decomposers**) break down the dead plants and animals into new food for the plants.



Soil has 3 types of particles: clay (smallest), silt, and sand (biggest).
The way these particles stick together is called **structure**. All soils in Texas have different amounts of these 3 particles. The best soil for gardening is a combination called **sandy loam**, which is 50 percent **sand**, 25 percent **silt**, and 25 percent **clay**. All types of soil can be changed into loam by adding compost. Healthy planting soil in our garden includes about 50 percent particles of sandy loam, 25 percent water, and 25 percent air/oxygen.

Texture is also important. Soil with lots of composted organic matter in it becomes nice and crumbly. We call this desirable **texture** good **tilth.**

Good soil also has lots of empty spaces in it called pores. Pores are filled with water and/or air. Plant roots and all the soil organisms need water and air to survive. Sandy soil has the most pores. **Sand particles are large** so they don't stick together very well.
Clay particles are smallest so they stick together tightly.

Would water drain well through clay soil? _____

Would plant roots grow longer in sandy soil or clay soil? _____

What would happen if the pores were filled with water? _____

Soil is also sometimes described in layers. The top layer is called **topsoil**. Topsoil is alive with roots of plants, bacteria, fungi (**microorganisms)**, and all kinds of creatures (**macro organisms**). The bottom layer is the **rock parent of soil**.

Would plant roots grow better in thin or deep topsoil? _____

What is the parent of soil? _____

List 3 things that can break down the parent of soil. 1. _____

2. _____ 3. _____

Bonus questions: what type of soil would erode more quickly, sand or clay? _____
What type of soil will hold water the most? _____
What type of soil will hold water the least? _____
Explain your answers: _____

_____

Healthy Soil

The most basic and important of all gardening topics is the soil in which we place our plants. Sometimes we call it “dirt”, but we should always strive to have “soil” not “dirt” in our gardens. We add nothing to our garden soil but organic products, including lots of compost made by fifth graders. We have changed what was “poor dirt” into healthy soil by adding compost and other organic **fertilizers**.

Healthy soil has lots of food for plants, including the 3 major elements, nitrogen (N), phosphorous (P), potassium (K), and trace elements.
To make sure that our plants have all the food that they need to grow, we use **fertilizer** in the garden. A typical fertilizer includes the elements nitrogen (N), phosphorus, (P) and potassium (K). The percentages of nitrogen, phosphorous and potassium are listed in the order N-P-K. For example a reading of 13-13-13 on the outside of the bag means that a fertilizer has 13 parts of nitrogen, 13 parts of phosphorous and 13 parts of potassium, which equal 39 parts. Those 39 parts are 39 parts of the 100 parts of material inside the bag. The 61 parts of 100 that are not nitrogen, phosphorous, or potassium are filler material that is not food for the plants.
Fertilizer that is made from non-living materials is called **inorganic**. Fertilizer made from decomposed once-living material is called **organic**. While nitrogen, phosphorous and potassium may be the most important nutrients for plant health and growth, other elements are also important. Often these other elements are called **trace elements** and can include almost any of the 118 elements on the Periodic Table of Elements. Organic fertilizers are important for healthy plants because they naturally have trace elements in them. Many soils lack the trace elements needed for the food plants we grow.

The phrase, “up, down, and all around” is an easy way to remember how the elements N, P, K are generally used by plants.
N - Nitrogen – **Up** – is important for strong stems and leafy growth. A high number should increase **green growth**.
P - Phosphorus – **Down** – helps to produce lots of flowers and healthy roots. A high number should **increase the number of flowers** and consequently that of fruit and vegetables.
K - Potassium – **All Around** – is essential to the **overall health** of the plant.

Good garden soil includes lots of organic matter, micro organisms and macro organisms.
The problem with many inorganic or chemical fertilizers and pesticides is that they kill off the microorganisms and macro organisms that help to improve the soil. All of these creatures are miniature compost heaps moving though the soil eating organic matter and releasing **humus** which is beneficial and useful for the plant roots. For the microbes to be healthy, we need to add compost or other organic components to the soil. We often do this by mulching around the plants with shredded grass clippings and pine needles and other kinds of leaves. Healthy soil is a work in progress. No matter how good our soil is, it can always be improved. The important thing to remember is not to take it for granted!

If plant leaves are looking yellow, what element are they lacking? _____

What element, among others, makes plants flower well? _____

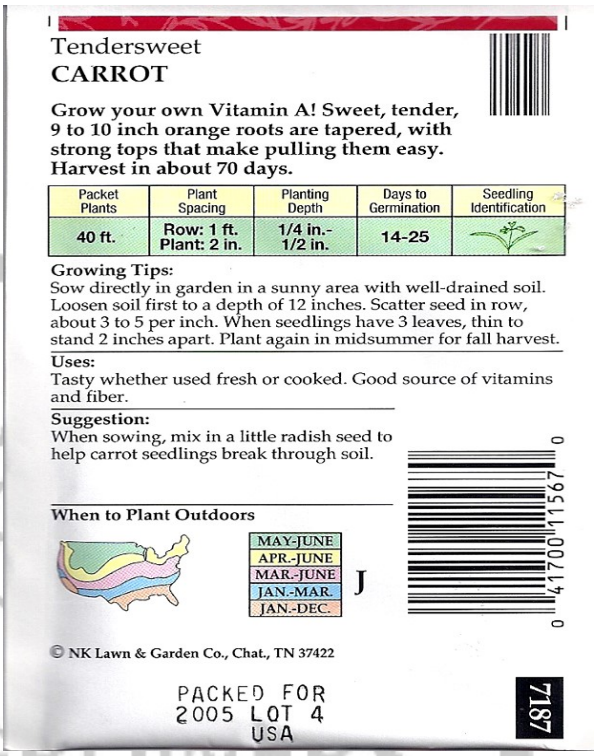
If a plant disease is going around, what element would help your plants fight it off? _____

If a bag of fertilizer has a 14-14-14 NPK, what percentage of fertilizer is in it? _____

What is the percentage of “filler” in this bag? _____

Reading and Understanding Seed Packets

Most seed packets have lots of information printed on them. Sometimes it is inside. If you read it carefully and follow all the advice you will have much better results!



Seeds are the result of **pollination** and **fertilization**. Seeds contain all the material a plant needs to reproduce itself. An embryo of the plant is inside each seed.
Seeds come in different shapes, colors and sizes. Seeds have a protective coat that can be thin, thick or hard. Seeds can be spread by wind, water, and animals.

Answer these questions after reading the package label above:

1. How **deep** and how far **apart** should you plant these carrot seeds?
   _____
2. How much time is required for the seeds to **germinate**? _____

   What does **germination** mean? (Please refer to the glossary near the back of this manual.)

   _____
3. How far apart should these plants be after **thinning**? _____
4. How long must we wait to harvest these carrots after planting them? _____
5. What type of soil is recommended? _____
6. When should these seeds be planted? _____Where else can you find this information?

   _____
7. Since plants are living organisms, what five things do they need to live?
   _____

   _____

Potted Plant and Seed Planting Guide

Planting plants from pots (transplanting):

Plants are usually purchased in plastic pots called nursery pots.

1) Always prepare the soil prior to planting. Preparation may require weeding, digging, and chopping the soil into small particles.
2) Fertilize the soil with an organic product following the directions on the package. Mix this into the soil with a rake, shovel, or hoe.
3) If the soil is very dry, use water from a hose or watering can to moisten it.
4) Mark where you want the plants to be by considering how big they will grow when mature.
5) Dig a hole slightly larger than the pot.
6) Add compost to the hole and mix it with the surrounding soil.
7) Hold the bottom of the pot in one hand and put the other hand and fingers over the top of the pot.
8) Turn the pot upside down and gently tap it until the plant falls into your hand, being careful not to break the plant. Remove the plant from the pot close to the planting hole.
9) If the roots are concentrated around the edge or the bottom of the pot, pull them apart gently.
10) Place the root ball into the hole so that the base of the plant is at the same level as the surrounding soil.
11) Close the hole and form a small bowl of soil with the plant in the middle.
12) Mulch with compost around the plant. Place the plant ID next to the plant.
13) Water the plant with a liquid organic fertilizer in a watering can. Carefully measure the amount of fertilizer according to the directions on the bottle!
14) Water and fertilize the plants until they are mature.
15) You may have to stake or cage plants that will grow tall.

Seeds:

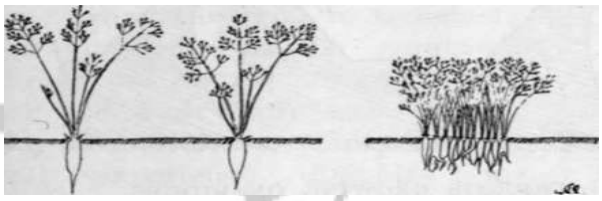
1) Prepare the soil before planting. Preparation sometimes requires weeding, digging, and chopping the soil into smaller particles.
2) Fertilize the soil with an organic fertilizer according to the directions on the package.
3) Mix the fertilizer into the soil with a rake, shovel, or hoe.
4) Read all the directions on the seed package.
5) Plant seeds according to the package directions.
6) Plant only the number of seeds according to directions on the package.
7) Cover seeds with the amount of soil/compost according to the directions on the package.
8) Water in the new seeds being careful not to wash the seeds out. Keep the area moist until seeds germinate.
9) Mark the row with the name of what is planted and the date it was planted.
10) Thin seedlings to the number of plants recommended on package.
11) Water and fertilize the plants as necessary.
12) Keep the seed package for future reference.

It is usually cheaper to buy a package of seeds than a young plant. (We get lots of seeds for about the same price as one plant.) Why would we not always grow plants from seed?

GROWERS.ORG

Thinning Seedlings

"You just planted me and now you want to pull me up! I like being really close to my friends and sharing all the good soil, fertilizer, and water. Why can I not just stay where I am?"



Seeds are planted close together for at least a few reasons:

- Sometimes the seeds are so tiny it is hard to separate them.
- Planting seeds at proper distances takes a lot of time.
- Some seeds do not germinate, so extra ones need to be planted.

Some of the newly germinated seedlings are removed for at least a few reasons:

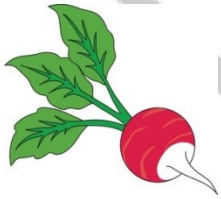
- They have more room to grow.
- Air can flow more freely around the plants.
- The remaining seedlings have less competition for food, water, and sunlight.

The process of removing the excess seedlings is called **thinning**. It is not a favorite job of most gardeners and sometimes seems wasteful. However, it will result in a better crop. In fact, if you do not do it you may not have a good crop!

Seedlings may be thinned by pulling them from the ground. Sometimes pulling plants disturbs the soil and interrupts the growing process of nearby plants. To avoid disturbing the seedlings that we wish to keep, we can use scissors to snip unwanted plants at ground level.

Question: Can you name three reasons to thin seedlings?

_____



_____

_____

Your carrot bed is 30 inches by 24 inches.

If carrots are planted 1inch apart, about how many carrots should we be able to harvest?

_____

Leafy Greens: Lettuce, Spinach, Swiss Chard, Arugula, and French Sorrel

Nutritional Components of Leafy Greens
Carbohydrates
Water
Minerals calcium, magnesium, sodium, potassium, and iron
Vitamins A, E, C, K, B2 (riboflavin), B6 (pyridoxine), and B9 (folate)

Lettuce: This fast growing annual in the sunflower family **Asteraceae** was one of the 1st plants brought to the New World by early explorers. It varies in color from light green to reddish brown and falls into 2 main categories - leaf lettuce and head lettuce.

As a cool weather vegetable lettuce may be planted in January, and October. Since the seeds are extremely small, one of the simplest methods of planting is to sow them in rows, cover them with ¼ inch to ½ inch of good compost and then water them carefully. The seedlings will need to be thinned for good growth. Planting seeds every 7 to 10 days will guarantee a continuous supply of lettuce. By cutting the outer leaves and leaving the young inner ones to further develop, you may extend your harvest period for a long time. When temperatures rise, the leaves become bitter. The lettuce will then **bolt,** (forms a seed stalk that grows rapidly). Bolted lettuce should be added to the compost pile.

Spinach: Native to southwest Asia, this cool weather vegetable has a high nutritional value and is a rich source of vitamins, minerals and antioxidants. Spinach is a member of the **Amaranthaceae** family.

The 3 types of spinach – crinkle leaf, smooth leaf and semi-crinkled (a hybrid) - are best planted here in mid-October and may also be planted in early spring. Plant the seeds ½ inch deep and 2 inches apart. Like lettuce seedlings, spinach seedlings will need to be thinned for best results. Continual sowing and appropriate cutting will prolong the harvest season.

Swiss Chard: This is native to the Mediterranean region and is in the **Amaranthaceae** family. Swiss chard is also very nutritional. Many people hate to cut this plant because of its shiny green, ribbed leaves and white, yellow, or red stems. In fact, Swiss chard is grown in many flower gardens because of its pretty leaves. We usually buy young plants and transplant them in early spring. The young leaves may be used in salads while the more mature leaves and stems are best cooked. Swiss chard is very perishable and must be used soon after harvesting. Swiss chard, spinach and beets are in the same family.

Arugula: Arugula is a cool-season leafy green that is sometimes sold as an herb. However, its peppery taste is wonderful raw in salads. Italian cooks also use it in many dishes. It belongs to the cabbage or mustard family **Brassicaceae, or Brassica** for short.

French Sorrel: French sorrel, often classified as an herb, is an unusual leafy green that is a perennial here. It is native to the mountains of southern and central Europe and southwest Asia and is in the **Polygonaceae** family. We usually plant purchased seedlings. French sorrel has green shield-shaped leaves and a sour, lemon-like taste. The sour taste comes from the high vitamin C content of the plant. French sorrel is also high in vitamin A and iron. It may be added to soups and spinach and chard dishes. It is great eaten raw in salads with other greens. One of our favorite ways to eat it is instead of lettuce in sandwiches.

Questions: **What do we mean by cool season plant?** _____

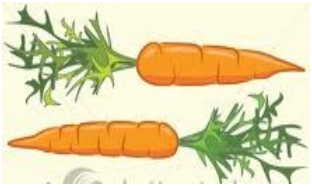
_____

What leafy green is usually NOT eaten cooked? _____

Which leafy green is a member of the Brassica plant family? _____

Instead of drinking orange juice, which leafy green could be eaten? _____

Root Crops: Carrots and Turnips

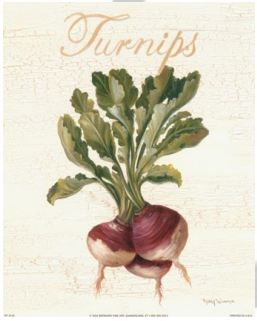


Carrots: Carrots are in the **Apiaceae** family along with celery, parsley and fennel. Our carrot bed is a raised bed that is roughly 16 inches deep and is filled with a sandy soil mixture. Soil depth should be 10 to 12 inches for carrots. If the root hits a hard spot, it will become deformed and the carrot, which is the root, will not be long and straight. A sunny location is important. Carrots should be planted in September or January. Danver and Scarlet Nantes are good varieties for our climate. Few pests bother our carrots. We usually plant a crop of "Aggie" carrots just for fun. They are a maroon color on the outside and orange on the inside but taste the same as the regular carrots. Some people, especially Aggies, think that they taste sweeter than regular carrots.

Planting: Carrot seeds are very small and may take 3 weeks to **germinate**. They should be planted about 1 inch apart and ¼ inch deep. Be prepared to thin the seedlings to 2 inches apart as soon they are ½ inch tall. Like radishes, they will not grow well if crowded. Once planted, they should be kept moist until the roots are well down into the soil. Do not let the bed dry out.

Fertilize them every 4 weeks with an organic fertilizer. Adding mulch around the plants will help conserve moisture and keep weed growth down.

Harvest a carrot when the top of the root is the size of a nickel. You can brush a bit of soil away to see how big it is. Pull firmly being careful not to break the top of the plant away from the carrot below ground. Mature carrots should be about 1 inch thick. Put the tops in the compost heap to make compost for next year.



Turnips: Both the leaves and roots of turnips may be eaten. Again, as with carrots, the soil should be well prepared and organically enriched.

Planting: Sow the seeds ¼ inch to ½ inch deep under compost in rows that are 9 inches to 10 inches apart. Space or thin the young plants to about 5 inches apart.

Fertilize the plants with liquid organic fertilizer regularly. Keep the area free of weeds and watch for infestation by various insects.

Harvest the turnips anytime from 5 weeks to 8 weeks. Do not leave them in the ground too long as they may become tough. Leaves may be harvested at any time during the growing season.

Questions:

Which root crops have edible leaves? _____

Why is it important to have these root crops spaced properly? _____

_____

Where would we learn how far apart to space the plants? _____

Root Crops: Radishes and Beets

Nutritional Components of Root Crops
Carbohydrates
Water
Minerals calcium, magnesium, potassium, and iron
Vitamins A, C, B6 (pyridoxine), and B9 (folate)

Fall is the time to plant radishes, beets, carrots, and turnips. These plants are called **root crops**.

Root crops are plants with underground storage roots that act like containers that hold energy in the form of carbohydrates. Each plant is a single root that burrows into the ground, producing one vegetable.

These root crops all like cool weather and do not do well in our hot summers. They can be planted from seed beginning in late September.

The most important rule for success with root crops is to plant them in **well-drained, loose, fertile soil**. The soil must be free of rocks or anything that will hinder growth. Raised beds are great for root crops.

Radishes are in the **Brassicaceae** family and come in many colors and hundreds of varieties. You can experiment to see which grows the best and which tastes the best. Varieties we usually grow include Cherry Belle, French Breakfast, and Early Scarlet Globe.

Plant radish seeds in a spot with sun most of the day. Prepare the soil by fertilizing it with an organic fertilizer at the rate shown on the package. Plant the seeds in fine soil no more than ½ inch deep. Seeds should be spaced about 2 inches apart. Do not put more than one seed in one spot. Some seeds will not **germinate**; so, if a seed has not sprouted after 7 days, plant another seed in the same spot. If plants are closer than 2 inches they must be **thinned** to that distance. A crowded radish will not be a good radish. It is hard to thin the little plants, but you must if you want good radishes. When watering the beds, be gentle since the plants are very small.

Harvesting should take place when the round top of the radish is visible just above the soil line. A mature radish is usually larger than a quarter. Start looking to harvest 30 days after planting. When a radish is more than about 45 days old, it will probably not be good for eating. Any seedlings that have not developed a rounded root should be pulled and replaced with new seed. Remember to put the tops of the harvested plants in the compost heap to make more soil for next year.

Pests and additional fertilizer: You should not have to fertilize once the plant starts growing. Because radishes have few pests in their short lives, no spraying of any sort is necessary. Weeds must be removed, however.

Beets with their sturdy stalks are quite hardy. The roots may be eaten raw, steamed, roasted, or pickled and the young leaves may be prepared in the same way as other greens.

Plant the seeds about 1 ½ inches deep, 3 inches apart in rows about 1 foot apart in a fertilized bed. If they are planted this way, the seedlings will not need much thinning.

Fertilize the plants with a liquid organic fertilizer once a month. Water and weed them regularly.

Harvest beets when they are 1 inch to 2 inches in diameter. They may look impressive when larger, but they will not be as tasty.

Why are these vegetables called root crops? _____

Will they grow well in heavy soil? _____ **Why?** _____

_____

What do we mean by cool season crop? _____

Cole Crops: Cool or Cold-Weather Crops from the Cabbage Family

Nutritional Components of Cole Crops
Carbohydrates
Water
Protein
The mineral calcium
Vitamins A, E, C, K, and B6 (pyridoxine)

When we talk about **cole crops** people sometimes think we are talking about cold crops, and **cole** crops do grow in cool or cold weather. Lower temperatures are the only similarity, though, and the two words mean different things. We all know what cold means, but cole is certainly not a familiar term for most people. **Cole** refers to any plant belonging to the **Brassicaceae** family. The word cole comes from the Latin word for cabbage, caulis.

There are lots of different cole crops. They originated with wild cabbage in the Mediterranean region. Here is a list of the most common ones: **cabbage, broccoli, bok choy, mizuna, cauliflower, kale, Brussels sprouts, collards, kohlrabi, mustard, arugula, radishes, rutabagas and turnips.** Generally, with a cole crop, what you see is what you eat. The exceptions are the root crops in this family.

Cole crops are somewhat **cold tolerant**. Unlike tomatoes, peppers, cucumbers, and lots of other plants, they will survive temperatures below freezing (32 degrees F or 0 degrees C) without too much damage. That makes them ideal for our school garden during the months of November through March when we occasionally have nights below freezing. However, like many other plants, they prefer warmer weather and grow faster in sunshine and temperatures of 60 degrees to 70 degrees F. They will not grow well when temperatures are consistently above 70 degrees F.

In our garden we normally use transplants instead of seeds to grow these crops. When planting seeds you have to be careful to thin to the appropriate distance. It is often difficult to tell the difference between seedlings and weeds in the early stages. Most of these plants grow to be fairly large; they do need their space.

Cole crops are sometimes referred to as **health foods**. They are high in vitamin C, and the leafy crops are also high in vitamin A. Because vitamin C is not stored by the human body, a daily serving of a cole vegetable can fulfill that need for vitamin C. One seldom known fact is that kale, collards, and Brussels sprouts contain more protein than milk. Protein is necessary to build muscle and repair injuries to the body.

Many people mistakenly think that lettuce, spinach, Swiss chard and beets are cole crops because they are planted during our fall and winter months.
Now that you have read this page, you know that they belong to different families.

Questions:

Name your two favorite cole crops. _____ and _____

Are there any of the cole crops that you have not tasted? _____

To what family do the cole crops belong? _____

During what months are cole crops planted here? _____

What vitamins do you get when you eat cole crops? _____

Legumes: Peas and Beans

Nutritional Components of Legumes
Carbohydrates
Water
Protein
Vitamins A, K, B2 (riboflavin), B3 (niacin), B6 (pyridoxine), and B9 (folate)

Legumes are plants in the **Fabaceae** family. These plants have pods which are filled with seeds. We can eat the seeds or in some cases the pods of edible legumes like beans, peas, and peanuts. Other legumes include clover, blue bonnets, and red bud trees.
Most legumes can **fix nitrogen** in the soil. These plants contain **symbiotic** bacteria called rhizobia within nodules in their root systems, that can use nitrogen from the air to produce nitrogen compounds that help the plant to grow. When the plant dies, the nitrogen helps to fertilize the soil.

Sugar "Snap" or Edible Pod Peas

Mid-January is the time to begin preparing the planting beds for our sugar snap, or pod peas. The seeds should be spaced evenly about 2 inches apart and 1 inch deep. Trellises or fencing should already be in place when planting the seeds as sugar snap peas grow rapidly. Since peas are cool weather crops, we get a spring crop and frequently a fall crop if we plant in late September.

Harvesting should take place when the pods are full-sized, but not plump. We eat the whole pods because they have no fibrous strings. They are delicious when eaten fresh and are very popular in salads and stir fry dishes.

Beans and More Beans

The most widely grown beans in vegetable gardens are green beans. They like warm weather and well - drained soil. They come in both bush and pole (climbing) forms. Bush beans will grow to 1 foot in height, whereas pole beans take up less space but require a trellis or cage. Before planting seeds, one should treat them with nitrogen-fixing inoculants designed to improve growth and production. Seeds should be planted about 4 inches apart and 1 inch deep.
Fertilize soil before planting the seeds. Beans will not need much fertilizer afterwards. They can turn tough and bitter if they are not harvested every 3 days to 5 days. Harvesting or picking beans can be very time-consuming because they like to hide among the leaves, but the result is freshness and tastiness.

An unusual bean that we like to grow is the asparagus or yard-long bean. The pods form in pairs and grow vigorously to a length of 14 inches to 30 inches. They should be harvested frequently.

Questions:

When would we plant beans? _____

Using the planting chart, when can we plant sugar snap peas? _____

How do pole beans and sugar snap peas grow? _____

What does "nitrogen-fixing" mean? _____

_____

Bonus Question: What does symbiotic mean?

_____

_____

Onions and Garlic

Nutritional Components of Onions
Carbohydrates
Water
The mineral potassium
Vitamins C, B6 (pyridoxine), and B9 (folate**)**

Onions are members of the **Amaryllidaceae** or Amaryllis family. Varieties of this cool season vegetable can be grown from seeds, **sets**, or transplants. A young onion forms a top and then develops a **bulb**. The number and size of the leaves on top determine the size of the onion. There is one ring of onion for each leaf; a large leaf will create a large ring. Onions come in 3 bulb colors – white, yellow and red.

There are 2 main classes of onions: **long-day** and **short-day**. The long-day varieties are better suited for northern states while the short-day varieties grow well in the south. The short-day onion develops its bulb earlier in the year when there are about 12 hours of sunlight each day.

We prefer to plant **seedlings** (called **onion sets**) in January. The soil is prepared by adding rock phosphate and worm castings. The seedlings should be planted 1 inch deep and about 4 inches apart. Another option is to plant the seedlings closer together, then harvest every other onion about 8 to10 weeks after planting them. These onions can be used as 'green onions'. The remaining onions are allowed to continue to grow.

In our garden we plant the sets of a yellow variety called **Texas 1015Y** super sweet onion about January 15th. The sets were planted from seed on October 15. These onions are harvested about May 15th. The **1015Y onion** became the state vegetable of Texas in 1997

Onions should be fertilized with an organic fertilizer every 2 to 3 weeks until about 1 month before harvesting. Keep them evenly moist during the growing season. Extra water is needed as harvest time approaches. When the tops fall over in mid to late May, the onions are ready to harvest. The roots of the onion should be clipped and the top cut back to within 1 inch of the bulb. Store them in a cool, dry location.

Onions are a good source of fiber and are fat-free and low in calories. The average American eats 20 pounds of onions each year.

Why do you think these onions are called "1015 Y"? _____

What is an onion set? _____

Garlic is also in the Amaryllis family and forms bulbs underground. The bulbs are divided into sections called **cloves**. Cloves are used to plant a new crop of garlic. Garlic needs well-drained soil, organic fertilizer with some extra phosphorus added to it, sun, and a good layer of mulch to keep the roots cool. The cloves are planted with their pointed sides facing up and 6 inches apart. The cloves should be lightly covered with soil. Garlic is planted in the fall and harvested at the end of May.

We plant garlic that does not need a long time of temperatures below 45 degrees F. to form bulbs. The garlic we plant is generally a soft-neck variety. When the garlic plant is ready for harvest the stems or necks fall over. The stems or necks are soft. After the bulbs are harvested, they need to be dried or cured in a cool place with good air circulation. Once they are cured, they may be stored in a paper bag in the refrigerator.

Potatoes:

Regular or White Potatoes and Sweet Potatoes

Nutritional Components of Potatoes
Carbohydrates
Water
The mineral potassium
Vitamins A, C, B5 (pantothenic acid), and B6 (pyridoxine)

Two different kinds of potatoes are grown in the school garden. In January we plant regular potatoes (sometimes called white potatoes), which we harvest in May. In May we also plant sweet potatoes that we harvest in October or November.

White Potatoes:

- The potato is a member of the nightshade or **Solanaceae** Family.
- Leaves, stems, and green skin are somewhat toxic, and can cause an upset stomach if eaten.
- To plant new potatoes, cut an existing potato into several pieces with 2 or 3 **eyes** on each.
- Use a good organic fertilizer with phosphorous.
- As the potato plant grows "hill it up" with soil or compost around it to make the roots grow longer and produce more potatoes.
- White potatoes are ready to harvest when the plant dies back, usually in May. Dig carefully!
- Store the potatoes in a cool place (not the refrigerator) and out of sunlight.

Can the potato see with its eyes? _____

What particular nutrient is really important to potatoes? _____

Why do we add more soil around the potatoes as they grow? _____

Growing White Potatoes in Containers and Small Spaces:
Potato towers are an easy and fun way to grow white potatoes in containers without taking up much garden space. Find a spot in your yard with full sun. Ideally the spot will also be near a water outlet. Make a cylinder that is 3 feet to 4 feet tall and 2 feet to 3 feet wide out of chicken wire, heavy gauge wire, wooden fencing, or even old tires. Set the cage in the sunny location and secure the ends of the cage with wire fasteners. Line the inside of the cage with hay, straw, cardboard, or newspaper to prevent the soil from falling out and put a 4-inch-deep layer of compost or fine soil in the bottom of the cage. Place 4 or 5 seed potatoes that have at least 3 "eyes" apiece on top of the compost and space them 6 inches apart. Cover the potatoes with a 3 inch to 4-inch-deep layer of soil. Water them well. As the potato plants grow, line more of the cage with newspaper and cover them with more compost. When the soil line is 6 inches from the top of the cage, stop adding soil as the potato plants grow out the top of the cage. Keep them well watered. In early summer when the plants start to yellow, remove the wire fasteners, open the cage, and harvest the potatoes. We hope you have fun growing potatoes in containers in your backyard!

Sweet Potatoes:

- They are not true potatoes but are **perennial** vines belonging to the **Convolvulaceae** or morning glory family. Also, sweet potatoes are not yams, which are in a different family.

  - They are grown from **vine cuttings** called "**slips**" rather than from seeds.
  - The young leaves and shoots are **edible** and may be eaten like spinach.
  - Plant the slips in a sunny location in loose, rich organic soil.
  - Use a good organic fertilizer as these plants grow fast.
- They need lots of sunshine and water.
- By mid-fall you can start digging the potatoes. The vines will not die back unless there is a freeze.

Are sweet potatoes also yams? _____

What parts of sweet potatoes can we eat? _____

When will we harvest sweet potatoes? _____

Tomatoes and Tomatillos

Nutritional Components of Tomatoes
Carbohydrates
Water
The mineral potassium
Vitamins A, C, E, K, B5 (pantothenic acid), B6 (pyridoxine), B7 (biotin), and B9 (folate)

Tomatoes, like white potatoes, are members of the nightshade family or **Solanaceae**. Tomatoes were discovered growing wild in the fields of Peru and Ecuador around 700 AD. They were once thought to be poisonous but are now the most popular plant in vegetable gardens. Most gardeners believe that a home-grown tomato tastes much better than one purchased in a store.

Successful tomato growing depends on a few factors: good soil, the right varieties, early planting, sunlight, consistent watering, and good fertilizing.

Planting: Bury tomato plants deeper than they grow in the pot. Bury them all the way up to a few top leaves. They are able to develop roots all along their stems. Frequently two seeds germinate in the same pot. Since you do not want them competing, one stem should be cut and placed in a container of water. Roots will form along the cut stem and the new plant will eventually be ready to join the other tomatoes in the garden.
Tomato plants need at least 8 hours of sunlight per day to produce a good crop. Raised beds with well-draining soil rich in organic matter encourage growth and production. Regular watering will avoid a number of problems. Most tomato plants stop blooming after daytime temperatures rise above 90 degrees F. or nighttime temperatures rise above 70 degrees F.

Each kind of tomato is in one of the following categories:
(1) Indeterminate tomato plants continue to grow in length through the growing season. Also referred to as "vining" tomatoes, **indeterminate** tomato varieties will set and ripen fruit over a long period until the weather becomes too hot or the plants are killed by frost. The fruits on indeterminate tomatoes are typically small.

(2) Determinate tomato plants are varieties that grow to a fixed size. Most of the fruits on a plant ripen in a short period, usually about 2 weeks. Once this first bunch of fruit has ripened, the plant will begin to diminish in vigor and set little to no new fruit. **Determinate** tomato plants are usually shorter than indeterminate and their fruits are larger than indeterminate varieties.

Tomatillos, or husk tomatoes, are also in the **Solanaceae** family and are considered a staple in Mexican cooking. The fruit is green and about the size of a cherry tomato. It is covered by a papery, inedible husk that is removed before use. The tomatillo plant needs a lot of space. At least 2 tomatillo plants must be planted together for cross pollination. Think salsa verde!

Questions:

If you wanted to make lots of spaghetti sauce at one time, would you plant determinate or indeterminate plants? _____ Why? _____

How many hours of sunlight should tomatoes have each day? _____

Most tomato plants will not set blooms when the daytime temperatures rise above _____ ° F and the nighttime temperatures stay above _____ ° F.

We usually harvest tomatoes just as they start to turn red and let them ripen on a counter or table.

Why do we not let them turn red on the vine? _____

Peppers and Eggplants

Peppers are tender, warm-season vegetables that originated in the Americas. They are all in the nightshade family. The plants require warm temperatures, grow more slowly, and are smaller than most tomato plants. We will plant our peppers in the garden about the beginning of April. They do not like cold temperatures. They should be fed once the weather gets warm. We usually buy plants from the garden centers instead of planting seeds**.**

Nutritional Components of Peppers and Eggplants
Carbohydrates
Water
The mineral potassium
Vitamins, A, C, K, B6 (pyridoxine), and B9 (folate)

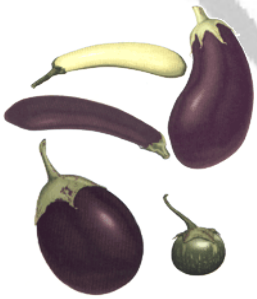
Varieties: There are hundreds from which to choose. The "sweet" varieties of peppers are the most popular in the U.S. In our garden we will be planting the traditional green bell peppers along with red, yellow, orange and purple peppers. Bell peppers start off green but can be left on the vine to ripen and develop color and flavor. Another sweet variety we like to grow is called banana pepper.

Peppers may taste hot or sweet. The chemical that makes some peppers taste "hot" is **capsaicin**. It can only be tasted by mammals. Some peppers are so "hot" that the capsaicin will blister exposed skin. This is why we only grow "sweet" peppers in the main garden, and hot peppers in the orchard.

Planting: Prepare the soil, dig holes slightly larger than the pots, and mix fertilizer and compost in the holes. Plant the **transplants** level with the soil in the pot. Add mulch around the peppers to keep out weeds and retain moisture. As the peppers develop, continue to fertilize them as they love to eat. Gardeners often make the mistake of using a fertilizer with too much nitrogen. The result is a great looking bushy, green plant, but with few peppers.

Do we feed peppers with lots of Nitrogen? _____ Why? _____

Eggplants were cultivated in China as early as 600 BC, but are thought to have originated in India before then. From India they spread to the Middle East where they became a popular Arabic food. By the 16th century eggplants were being grown throughout Europe.

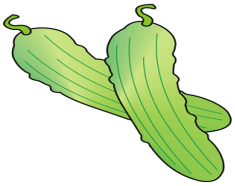


Eggplants are also a member of the **Solanaceae** family. They grow on a bush which produces variously shaped fruit over a long period. Our most common type is the glossy, smooth-skinned, teardrop-shaped eggplant with dark purple skin. The spongy flesh inside is white to creamy white and has many small **edible** seeds. Varieties may be long and thin, round, or egg shaped. Colors may be white, white with red stripes, to purplish-black, yellow or orange.

Planting: Eggplants need the same growing conditions as tomatoes and peppers and are planted around the same time of year. Typically, we purchase seedlings to plant in the garden. Eggplants mature in about 70 days.

Harvesting: Cut the stem of the eggplant with a pruner when it is a mature size, which varies with different varieties. Handle eggplants gently as they are damaged easily. Eggplants do not store well so it is best to use them soon after they are harvested.

Cucumbers, Squash, Pumpkins and Gourds



Nutritional Components of Cucumbers and Squash
Carbohydrates
Water
Protein
The mineral potassium
Vitamins A, C, K, B6 (pyridoxine), and B9 (folate)

Cucumbers and squash, along with pumpkins and gourds are members of the **Cucurbitaceae** family. Hundreds of cucumbers are grown at Oak Forest each year. Cucumbers grow on a vine with large leaves that shade the fruit as they grow. The vine will spread over quite a large area on the ground or climb a trellis**.** We have found that letting cucumber vines climb one of the fences in the garden gives us the best results. We plant seeds in late March or early April and are able to pick many cucumbers before school is out in June. They need lots of water.

Cucumbers grow very quickly and because of this rapid growth need lots of food. When they are planted, they are given lots of compost and organic matter. As they grow, side dressings of organic fertilizer every four weeks or an application of liquid fertilizer will give them a much-needed boost. If watered well and fed periodically, plants can last the entire summer.

Cucumber vines eventually produce flowers. A female flower is pollinated by an insect that has just visited a male flower to collect pollen. Then the female flower starts to produce the cucumber at its base. Because bees are the most important pollinators for cucumbers, any decrease in the population of bees results in fewer fruits. **Bees and plants have a symbiotic relationship**.

There are many varieties of cucumbers. The bush variety, although still a vine, takes less room than the standard cucumbers. We grow burpless, Asian, and Armenian varieties. A small type of cucumber is grown for pickling. Cucumber skin contains cucurbitacin, a chemical that makes humans burp. Burpless varieties contain less of this chemical.

Since cucumbers contain a lot of water, they are refreshing eaten cold on a hot day. They also have lots of vitamins and other healthful nutrients. Many of these are in the skin, which should be left unpeeled for eating.

Squash: There are two basic types of squash: winter squash and summer squash. We grow several varieties of summer squash in our garden. These are planted in April and usually produce squash by the time school lets out. Sometimes we can harvest squash all summer. The plants like fertilizer, compost, sun, and lots of water. Some of the summer types that are grown at Oak Forest include yellow straight neck and crookneck, zucchini, patty pan, and eight ball. These have soft skins and don't store for long periods of time. They should be eaten quickly.

Winter squashes do not grow as well here, which is why we typically do not plant them in the garden. They do have hard skins and keep for long periods of time. Some of them can grow very large, up to 1000 pounds! Hubbard, acorn, spaghetti, and butternut are some of the popular winter squashes. Some are used to make delicious pies!

Plant all squashes at the proper time of the year. (Use the planting guide.) Plant them where they will get full sun. Good loose soil enriched with organic matter is important. We mulch around the plants after the seeds **germinate** to keep weeds down and moisture in the soil. Fertilize the vines often with organic fertilizer. Keep them well watered especially if there is not much rain.

Pests: All these plants can get a number of pests and diseases. The four you should look for in the garden are powdery mildew disease, squash bugs, squash vine borers, and cucumber beetles. There are organic ways to treat these pests and it is not really necessary to use chemical toxins to kill them. Use suggested web sites to research these pests and find **reasonable** ways to treat them. For many of these pests, hand removal is as effective as any other method. Healthy soil and the proper amount of water will keep your plants from becoming stressed and attracting these pests.

Cucumbers, Squash, Pumpkins and Gourds, continued

Harvest: For a good harvest of cucumbers or squash these plants should be picked daily. The more you harvest the more the plants will produce. If you let some of the fruit grow too large, the seeds will mature inside. Those mature seeds tell the plant to cut back on production or die. **Pick cucumbers and squash every other day; don't let them get too big!** Compost any rotten ones.

How often should you check and pick your cucumbers/squash? _____

Pumpkins: Large pumpkins are not grown at Oak Forest since they are very big plants and would soon cover the whole garden. You will plant pumpkin seeds in a small pot in March of next year. We always take the seeds from a Halloween pumpkin, let them dry in the shed, and then plant them. They will germinate about 2 weeks after planting. In about two more weeks you may take your pumpkin plant home to plant wherever you wish**.**

Do you like Pumpkin Pie? _____

Nutritional Components of Pumpkins
Carbohydrates
Water
The mineral potassium
Vitamins A, C, E, B5 (pantothenic acid), B6 (pyridoxine), and B9 (folate)

World Record Pumpkin Pie
Baked in New Bremen, Ohio
3,699 Pounds

Gourds: Most gourds are not edible. Most gourds are used in many ornamental ways, or as containers. After a gourd is picked it must be hung up inside to dry. There are hundreds of different types of gourds. **Cucuzza** is a gourd that is edible. We often grow it on the arbor in the Annex garden. It grows long fruits which can be used in cooking as you would use a summer type of squash. They are often used in Italian cooking.

Harvest: It's best to leave pumpkins and gourds on the vine as long as possible to ensure that they are fully mature. Mature fruits will be fully colored. Thump them to see if they have a hollow sound inside. Try denting the rind with your fingernail; a mature pumpkin or winter squash may dent, but it will not puncture easily. The foliage should be starting to turn yellow and decline. The stems should be hard or starting to crack or turn brown. The exception is the Cucuzza. It should be picked when they are about 12" long.

What do all plants in the Cucurbitaceae family have in common? _____

What fertilizer would you use on these plants? _____

Where would you find a squash vine borer?

_____

Where would you find out how to treat a pest problem of one of these plants?

_____

Herbs

Herbs are defined as a variety of plants that are often aromatic and used especially in medicine or as seasoning. They fit into various classifications according to their uses – **culinary**, **aromatic**, **medicinal** and **ornamental**. We have divided them into two categories: **perennial** and **annual** herbs.

Culinary herbs are used in cooking and usually have a mild flavor. These two pages will concentrate on some of the culinary herbs that we grow in our garden.
Herbs are further divided into **perennials** (live for more than one season), **annuals** (live for only 1 season), and **biennials** (live for two seasons).
Perennial herbs that we grow in the OFE garden include chives, fennel, lemon balm, marjoram, Mexican mint marigold, oregano, rosemary, sage, thyme, Vietnamese coriander, and winter savory.
Annual herbs include basil, cilantro, dill, epazote, and stevia.
Biennial herbs include parsley and celery leaf.

All of our herbs need sun and well-drained soil but many of them appreciate a break from the hot afternoon sun. Cilantro, dill, and parsley are cool season herbs. We grow most herbs from transplants.
Note: Mint, lemon balm and Vietnamese coriander should be grown in pots since they can be **invasive** and crowd out other nearby plants.

Words to define:

Perennial _____

Annual _____

Culinary _____

Invasive _____

Harvesting and storing herbs:
Herbs should be harvested in the morning when their leaves are dry. The oils which give the herbs their flavor are removed by the heat of the sun. Herbs bruise easily so they should be handled carefully. They can be saved for use later on by wrapping them in damp paper towels. They can then be placed in the vegetable bin of the refrigerator. Some of the herbs also can be placed in a little vase with water. The herbs should be used soon after they are harvested. Parsley, dill, lemon balm, marjoram, Mexican mint marigold, oregano, rosemary, sage, thyme and winter savory can be dried and stored for later use in glass containers. Cilantro, parsley, dill, basil, Vietnamese coriander may be chopped and frozen in olive oil for later use.

Basil is a popular but tender annual that is native to India and Asia. It is grown for its aromatic leaves which can be used fresh in tomato and pesto sauces. Basil is also good with veal, lamb, fish, poultry and pasta. It should be cut just prior to the appearance of flowers. However, the flowers are beautiful and really attract bees and other pollinators.

Chives have beautiful purple blossoms that we rarely see. This perennial herb is native to the Orient and was first used by the Chinese. It has a mild onion flavor when added to fish, salad, steamed vegetables, soups, butter and omelets. To harvest chives, cut leaves 2 inches above the ground. The flowers are edible and can be used in a salad for a pretty look.

Herbs, continued

Garlic chives have a stronger garlic flavor. They tend to grow a little larger than onion chives and produce white flowers. These are probably the easiest herbs to grow. Both types freeze well and should be cut frequently to encourage new growth. Both can be divided for extra plants.

Cilantro seems to be one of the herbs that one either loves or hates, but it is a welcome addition to a garden since it attracts bees when it flowers. It is hard to imagine a spicy, Mexican salsa without the addition of cilantro. Surprisingly enough, it is not native to Latin America, but to the Mediterranean region. After cutting, keep the stems in water in the refrigerator until ready to use.

Dill is an annual, self-seeding plant with feathery green leaves. It is used most commonly in soups, stews, with fish and for pickling. Dill is easy to grow and attracts beneficial insects to the garden. It is a cool season plant in the carrot family.

Mint had its beginnings early in history. Greek athletes used bruised mint leaves as an after-bath lotion. In the Middle Ages, it was used to purify drinking water that had turned stale on long ocean voyages. There are many varieties of mint and most can be used to flavor teas and other drinks.

Mexican mint marigold is a perennial herb that is also used in flower beds. It is used as a substitute for tarragon. Tarragon will not easily grow here. It is used to flavor soups and sauces. The dried leaves and flowers make a pleasant anise-flavored tea that is popular in Latin America. The flowers can be eaten and are often used to make a yellow dye. The flower is one of the symbols used in Latin American Day of the Dead celebrations.

Oregano is commonly known as “the pizza herb”. This member of the mint family provides the flavoring to many Italian, Mexican and Spanish dishes. It is one of the few herbs whose dried leaves have a stronger taste that the fresh leaves. However, the largest use of this hardy perennial is in perfumes.

Parsley comes in curly as well as flat-leaved varieties. Leaves can be harvested as soon as the plant is 6 inches tall and stored fresh, frozen or dried. Although frequently used as a garnish, its mild flavor allows parsley to be added to many dishes. It also freezes well. If chewed, it is also a good breath freshener.

Rosemary has leaves with a leather-like appearance and spicy fragrance. Rosemary is a hardy evergreen in our area of the country. It is a popular flavoring for meats, potatoes and dressings or as a garnish on large roasts. Stems stripped of their leaves can be used as skewers when grilling. Oil from leaves is used in medicine.

Sage is a Mediterranean native evergreen herb with a strong, aromatic flavor. It has very striking wooly gray-green leaves which, when chopped, add a wonderful taste to soups, sauces and stuffing, especially turkey.

Thyme is one of the most useful kitchen herbs. It is also used as a border or ground cover, since many varieties are low growing. One of the favorites is lemon thyme with its delicate scent of lemon and spice which is best when enjoyed fresh. It is often used in gumbos, chowders and poultry stuffing.

Vietnamese coriander is called *rau ram* in Vietnam. It is used in Asian cooking, but is a wonderful substitute for cilantro. Since it is a perennial, this can be useful in the summer when cilantro will not grow here.

Winter savory is a low-growing, evergreen perennial herb. The Romans used this herb for cooking and introduced it to England during the reign of Caesar. Fresh or dried winter savory leaves are used to flavor vinegars, herb butters, bean dishes, creamy soups, and tea.

What herb is used in salsa? _____

If you need a breath freshener, what herb leaves could you chew? _____

What herbs could you use in drinks? _____

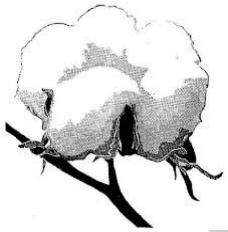
Okra and Cotton

Nutritional Components of Okra
Protein
The minerals calcium, magnesium, phosphorus, potassium, and zinc
Vitamins A, C, K, and B6 (folate)

Okra is part of the mallow or hibiscus family, **Malvaceae.** Okra is traditionally a southern U.S. plant that thrives in warm weather. Okra originated in Africa. It may have been first brought to North America by French colonists who settled Louisiana in the 1700s. Thomas Jefferson said it was known in Virginia before 1781.

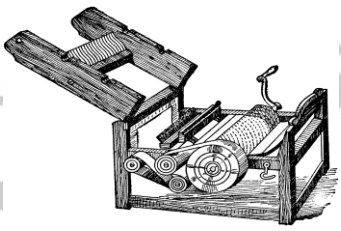
Okra is easy to grow and use and looks great throughout the growing season due to its beautiful flowers. It should be planted in fertile well-drained soil in full sunlight about 1/2 inch to 1 inch deep and 6 inches apart. Okra plants are tall and wide. Be sure to space the rows 3 feet to 4 feet apart. When the seedlings are about 3 inches tall, thin the plants so that they are about twelve inches apart. Keep the plants well-watered throughout the summer months; 1 inch of water per week is ideal. Fertilize once per month with a complete organic fertilizer like Microlife.

The first harvest will be ready about 2 months after planting. Once the okra is producing pods, it should be harvested every other day when the pods are about 2 inches to 3 inches long. Allowing the pods to get larger will stop the plant from producing more pods. Cut the stem just above the cap with a clipper; if the stem is too hard to cut, the pod is probably too old to eat and should be composted. Wear gloves and long sleeves when cutting okra because most varieties are covered with tiny spines that may irritate your skin. However, this irritation will not happen when you eat them. We grow several “spineless” varieties at OFE, such as ‘Annie Oakley’ and ‘Clemson Spineless’. A shorter variety that we grow is called ‘Jambalaya’. Okra is rich in vitamins A and C, high in fiber, and low in calories. It is often eaten in gumbo and jambalaya, and may be fried, grilled, pickled or stewed with tomatoes.



Cotton: Texas leads the states in the U.S. in the production of cotton. The U.S.A. produces about 20 percent of the world’s cotton. Much of the economy of Texas was dependent on cotton in the 1800’s, and that dependence continues today. It is estimated that over 50 per cent of the cloth and clothing in the world are made from cotton.

We have successfully grown cotton plants at OFE a number of years. One plant had over 50 cotton bolls on it one year. Commercially, cotton is grown from seed. Cotton typically has beautiful white flowers and white fibers. The **cotton boll** or seed pod forms after the bloom and then puffs out to reveal the cotton. Other varieties have fibers of other colors such as brown and green. Aggie cotton has maroon leaves and beautiful pink flowers but white fibers. Look in the garden to see if we have cotton growing.



A machine called a **cotton gin** is used to remove the seeds from the fiber without breaking the fiber.

Cotton likes lots of compost and fertilizer and should be planted in full sun. Cotton also requires a fair amount of water. Be prepared to water it if there is no rain. Since cotton tends to take many of the nutrients from the soil, the pods, stalks, and seeds are often ground up and processed into products called cotton seed meal and cotton burr compost. We often use these products as an organic fertilizer in our gardens when planting tomatoes, peppers, and other vegetables. Some “old time” farmers insist that adding cotton seed meal to tomato plants improves the taste of the tomatoes.

Okra and cotton have a long history in Texas. They are very important to the Texas economy. They also are fun to grow in our garden.

Sugarcane: A Sweet Grass

Most plants grown in the 5th grade garden are fruits or vegetables just like you can grow at home. Sugarcane is not normally grown in a backyard garden but we do grow some in the school garden. It has great historical significance to our area.

Sugarcane is a tall **grass** plant with stout stalks rich in sugar. Sugarcane is native to southern Asia and has been grown in India and China for more than 3,000 years. Columbus is believed to have carried it from the Canary Islands to the West Indies. Louisiana colonists were raising the plant by the middle of the 18th century.

Sugarcane is a plant of the tropics and sub tropics, and needs lots of warm weather to grow. Where summers are not long enough to grow it, sugar beets are grown as another source of sugar. Sugarcane is planted by laying sections of stalk lengthwise in furrows. New plants spring from the buds or nodes found on the stalks. In the USA it is mostly grown in Louisiana, Texas, Florida and Hawaii. In Texas it takes about nine months for the cane to be ready for harvest. In many fields fires are set to burn the leaves off the stalks before they are harvested. If you drive through sugarcane fields in the fall you might smell the sweet-smelling smoke.

Have you ever been to Sugarland, Texas? This city just southwest of Houston was the sugar capital of the US in the early 1900s. As the home of Imperial Sugar Company which had a sugarcane refinery and large fields of sugarcane, the city became a very important part of the economy in South Texas.

The US produces about 28 million tons of sugarcane a year.

How is sugar made from sugarcane? Sugarcane is harvested by chopping down the stems but leaving the roots so that it re-grows in time for the next crop. The cane is sent to factories where it is crushed in a series of large roller mills. The sweet juice comes gushing out and the remaining fiber, **bagasse**, is carried away for other uses. This impure juice is cleaned by another process. Then the purified juice is thickened into syrup by boiling off the water. In the last stage, the syrup is placed into a very large pan for boiling. In the pan even more water is boiled off until conditions are right for sugar crystals to grow. Once the crystals have grown the resulting mixture of crystals and remaining liquid is spun in centrifuges to separate the two. The crystals are then given a final dry with hot air before being stored for packaging.

Sugarcane is the source of a number of products other than sugar. Among these products are molasses, which is made by boiling sugarcane juice, and rum, which is distilled from fermented molasses or sugarcane juice. The bagasse is used in many ways.

What can you do with your node of sugarcane? Each stalk has many sections that have buds or **nodes** where leaves and roots will grow. Each node, if planted in damp warm soil, may sprout a new sugarcane plant. It can be started in a large pot in the fall, and transplanted to a sunny spot in your yard in early spring. If you have a sweet tooth, simply cut off a bite-size chunk of the stalk and peel it. Cut that into sections and chew it like chewing gum. In many countries peeled sugarcane is used as a type of candy. The peeled stalks can be used in fruit punches somewhat like swizzle sticks.

How do you plant a sugarcane node? _____

_____

When would you transplant your sugarcane seedling into the ground? _____

What plant is another source of commercial sugar? _____

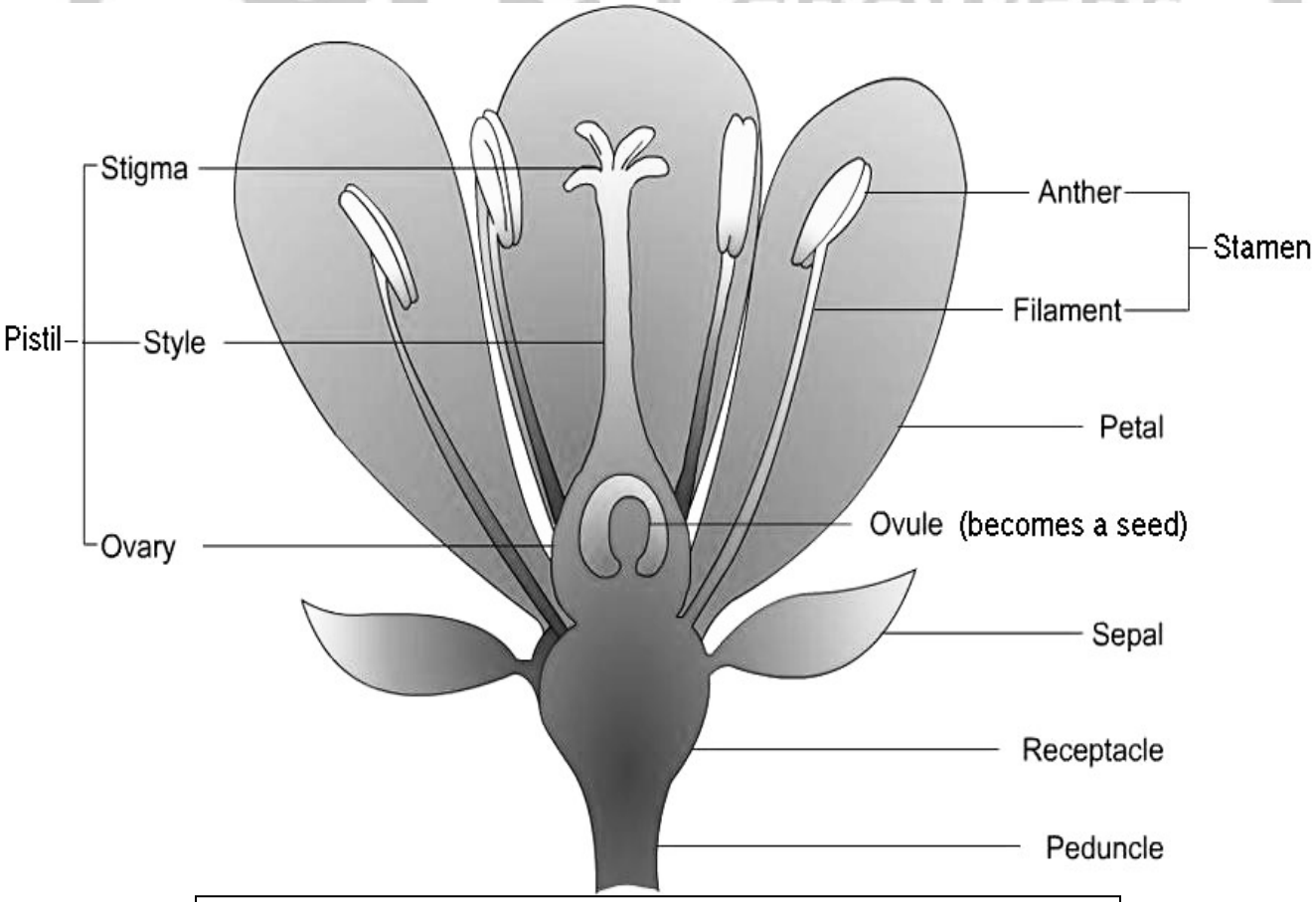
Pollination

The transfer of pollen from the **anthers** (the top of the stamen) of a flower to the sticky top of the **pistil (stigma)** of the **same flower** or of another flower is called **pollination**. **Pollination** is necessary for **fertilization** which allows the flower to develop seeds.

Some flowers will develop seeds as a result of **self-pollination**, when pollen and pistil are from the same plant, often (but not always) from the same flower. Other plants require **cross pollination** where the **pollen** and pistil must be from **different plants** of the same type. **Pollination** results in **fertilization**. Most plants need help moving pollen from one flower to the pistil of another. Birds and insects are responsible for pollinating many flowers. Animals that are known to be good **pollinators** of flowers include bees, butterflies, hummingbirds, moths, some flies, some wasps, and nectar-feeding bats. They knock **pollen** off the **anther** and onto the **pistil.** Rain and wind also help in pollination.

A **seed** is formed when the **pollen** meets the **ovule (egg)** in the **ovary** of a flower. Seeds are usually formed in a **fruit**. A mature fruit releases its seeds. The seeds land on soil and create new plants. Seeds move away from parent plants in many ways. By being moved, the seeds can grow in a place where there is enough water, food and light.

Can you think of ways a seed can move? _____



Parts of a Flower

Pollination, continued

The U.S. Department of Agriculture estimates that about 35 percent of the human diet comes from insect pollinated plants. Bees are responsible for 80 percent of this amount.

Honeybee

Wasp

Bumblebee

Normally we think of the honeybee as the chief pollinator in our gardens, but there are over **3,500 varieties of bees** in the United States alone.
Many people are confused about the difference between a bee and a wasp, and most people do not realize that some flies look very much like a bee or wasp.

Other types of bees include bumble bees, sweat bees, carpenter bees, leafcutter bees and at least another 3,496 varieties. Often these bees are called solitary bees, native bees, or pollen bees. Many are specialists and pollinate only one type of plant.

Since pollinators are so very important to our food supply, we should do everything we can to protect and encourage them. **Native pollinators** are much better pollinators than European honey bees. They are in trouble due to **habitat destruction** and widespread **pesticide** use. We can help native pollinators survive by planting native plants, providing nesting places and water. They prefer meadows filled with native plants. We can also build nesting boxes for some of the pollinators. Protecting our native pollinators is very important to our future food supply.

While you are in the garden today, look at the flowers on different plants and see if you can see a bee or other insect that is being a **pollinator**. If the insect is a bee, what kind is it?
Try to identify the **parts** of a flower.

Pollination is the transfer of _____ from _____ to _____.

Pollination results in _____.

Fertilization results in _____ being formed.

Name five agents of pollination. 1. _____ 2. _____

3. _____ 4. _____ 5. _____

Are European honey bees the best pollinators? _____

Name three things that native pollinators need. 1. _____

2. _____ 3. _____

Honeybees

Honeybees, which have the scientific name *Apis mellifera*, have been around for millions of years. They are native to Europe. They are the only insects that make food that humans eat.

The hive is where all the bees in a colony live. A **colony** is like one big family where as many as 50,000 bees live together. In the hive, bees build **honeycombs** out of wax they make in their bodies. They shape the wax into **six-sided or hexagonal tubes** where they store honey and nectar and where the queen lays her eggs.

Honeybees are social and cooperative insects. Every honeybee has a special job within the hive. Members of the hive are divided into three types. Workers, which are sterile females, live up to 6 weeks. They forage for food (pollen and nectar from flowers); build, protect and clean the hive; and circulate air by beating their wings. Male bees, which are called drones, are responsible only for mating with a new queen bee. The hive contains only one queen bee which may live up to 5 years. Her job is to lay eggs, as many as 1600 per day, for the next generation of bees. A queen bee regulates the activities in the hive by producing chemicals that guide the behavior of the other bees.

Most of the bees you see flying are worker bees. Their wings beat incredibly fast, about 200 beats per second creating a buzzing sound. Worker bees can each fly up to six miles per day, and as fast as 15 miles per hour. They can visit up to 100 flowers in one collecting trip. Their sense of smell is so precise that it can tell hundreds of different flower varieties apart and tell whether a flower carries pollen or nectar. This sense of smell also lets them recognize members of their own hive. During its lifetime a worker bee makes only about 1/12th of a teaspoon of honey. The nectar that worker bees gather from flowers gives the honey a distinctive taste. Only worker bees sting if they feel threatened.
What happens to a honeybee if it stings you? _____

Honeybees pollinate more than 100 crops that are important to humans. They are incredibly important to our lives. If bees were to disappear, we humans would be in big trouble.
Is the honeybee the only insect that can pollinate plants? _____
Ways in which you can help our bees:

1. **Do not aggravate them. Never swat at them. Just stay calm and they will leave you alone**
2. **Provide them with a suitable place to live**
3. **Provide them with food and water in a convenient place**
4. **Use as little insecticide as possible (not even organic ones) in your garden**
5. **If you must spray an insecticide, do it in the evening when bees do not fly**

How many bees may live in a hive? _____

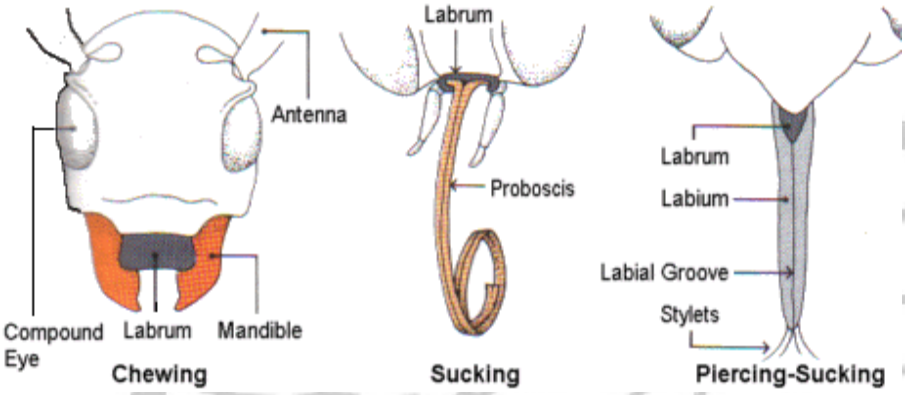
What is the main job of a queen bee? _____

What is the name of the shape of the waxy cells that bees build in their hive called?

_____

Insect Plant Damage

Insects that may damage our plants leave tell-tale signs that they have been on our plants. It is up to us to figure out what type of insect may have caused the damage, so that we know the proper way to discourage or eliminate that pest. So we need to become insect detectives. Of course, there are other creatures that cause damage to our plants such as some birds, rodents, snails or slugs to name a few.



Insects feed on plants in different ways according to their **mouthparts** at each stage of life. With some insects only the adult insect feeds on certain plants. In other insects the immature form may only eat certain plants. In other insects the adults have mouth parts different from those of the immature forms. There is a lot to learn!

(1) Insects with chewing mouthparts eat parts of a plant. They may eat all the leaves (**defoliate**). They may eat only portions of the leaf tissues between the veins (**skeletonize**). They may eat only the **edge** of leaves. Some may eat tiny holes in the leaves (**shot-hole**). Others may feed on particular layers inside of leaves (**leaf miners)** or bore into stems and roots (**borers**). Some insects with chewing mouth parts include caterpillars (the larval form of butterflies and moths), grasshoppers, some beetles and their larvae. Look for **frass** (bug poop) from chewing insects, especially caterpillars.

(2) Insects that feed with a long proboscis (a coiled straw) suck nectar from the centers of flowers. Butterflies and some moths feed by sucking nectar from flowers with their long proboscis.

(3) Insects with piercing and sucking mouthparts pierce the surface of the plant and suck out the sap from within. Because the green **chlorophyll** is also sucked from plants the parts discolor. Many plants react to the saliva and damage of sucking pests with curled leaves or twisted young stems.

Many insect pests stay on the plant at all times and so are easy to see. Others run or fly when disturbed; you may need to sneak up to the plant to avoid scaring the pests. Carefully approach the plant low to the ground and try to observe its upper and lower leaf surfaces without casting a shadow. Many other insect pests come out at night. Searching with a flashlight may reveal them.

Name an insect that feeds with a long proboscis. _____

Plant damage can also be the result of feeding by pests other than insects. **Can you think of a few non-insect pests that can damage our plants? _____**

Cabbages in the garden have big holes in their leaves. **What do you suspect is eating the cabbage?**

_____

What type of a mouth does the larval form of a butterfly or moth have? _____

If you see frass on the ground, what insect do you suspect? _____

What type of a feeding mechanism does a mosquito have? _____

If we see pale yellow patches on leaves, what kind of insect was feeding there? _____

Insects in the Garden

We see many kinds of insects in our gardens. People sometimes think that all insects are bad, but we know that many are necessary in order to grow vegetables and fruits. Many insects are **interdependent** with plants. Insects are neither good nor bad. All insects occupy a niche in our environment. We refer to some insects that harm our food crops as **pest insects**. As a good gardener you must learn the beneficial insects from the harmful ones before killing any of them. We can learn to identify them by looking in books or the Internet.
The word bug and insect are often used interchangeably. This is incorrect. **True bugs** are actually a **class of insects** that includes aphids, stink bugs, and cicadas. Spiders and spider mites are **arachnids,** not true insects.

Insects we may encounter in the garden include:

(1) **Ladybeetles** are usually red with black spots. There are many varieties of ladybeetles. They are predatory insects that feed on small, soft-bodied insects. Their immature forms also eat small insects.

(2) **Caterpillars** may be smooth or fuzzy. They are the immature form of butterflies and moths. Caterpillars eat plant parts. Some eat only one specific type of plant.

(3) **Bumblebees** are usually yellow and black in color. Bumblebees appear to be 'furry' compared to other bees. They are bigger than a honey bee and live in small nests rather than a hive. Bumblebees are good pollinators.

(4) **Beetle larvae** are also known as **grubs**. They are the immature stage of beetles. The larvae live in the soil and are usually white in color. Most beetle larvae eat dead plant material, but some eat the roots of plants.

(5) An **aphid** may be green or yellow or black. Aphids are small insects the size of a pin head. They suck plant juices from plant parts.

(6) A **praying mantis** is shaped like a stick and is green. They hide on plants. When other insects come by it grabs them with its front legs and eats them. Some people say it looks as though it is praying.

(7) **Stink bugs** are large, oval or shield-shaped insects. They get their common name from the odor of the chemical that they produce in glands on their abdomen. This odor might be a defense against predators. Many species of stinkbugs suck juices from plants. Some stinkbugs eat other insects.

(8) **Hover Flies** are small flies that **mimic** wasps. Their larvae, which look like tiny slugs, eat small insects like aphids and whiteflies. The adults are sometimes called flower flies because they eat nectar and pollen. They are about ¾" in size.

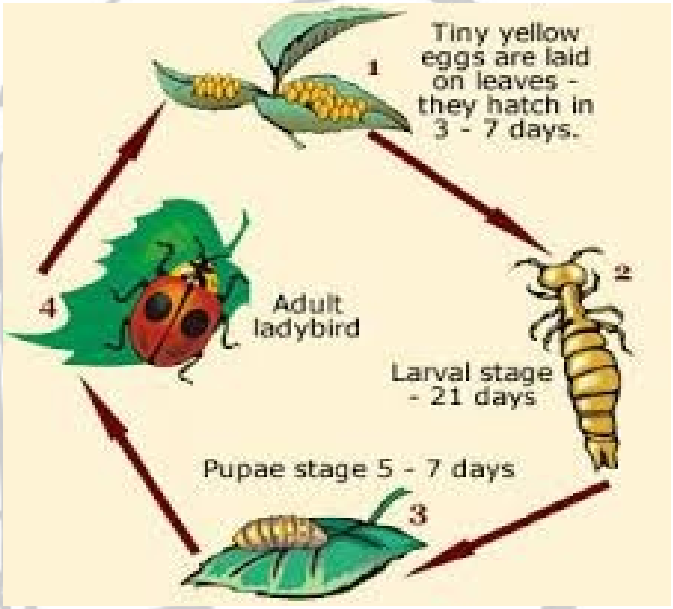
To eliminate pests from the garden to keep plants safe, always use the **least** toxic (poisonous) method to remove them. Sometimes removing the insects by hand is the best solution. It is not always necessary to remove a pest. Nature has a way of balancing insect populations. This is called natural control. Wait a day or two to allow that to happen.

Insect Metamorphosis

Metamorphosis is the process through which insects, and other creatures, develop, grow, and change form. The term is from Latin and Greek words. Meta means change and morphe means form. We will only talk about insect metamorphosis here.

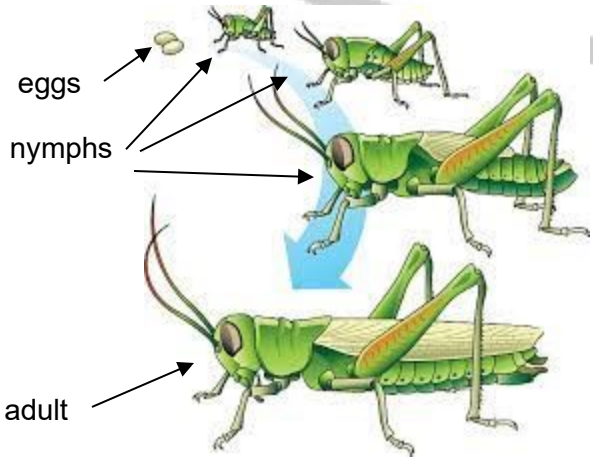
Metamorphosis describes the series of changes through which an insect passes in its growth from the egg stage through the immature stages to the adult stage. The most commonly described forms are **Complete Metamorphosis and Incomplete Metamorphosis.**

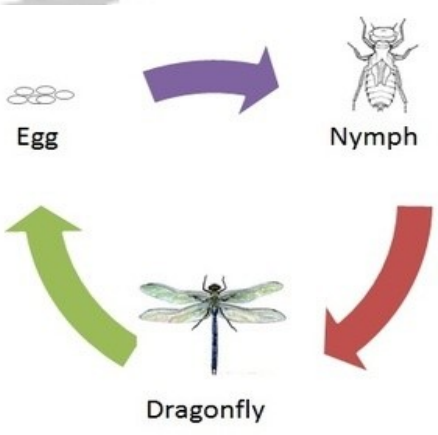
Insects that go through **complete metamorphosis** have four stages of development. They are egg, larva, pupa and adult. Almost 75 percent of insects grow this way and include flies, beetles, bees, butterflies, and moths.



Complete metamorphosis of a Ladybeetle
Note that the larval stage does not resemble the adult stage. Usually the larval form eats different foods than the adult.

Another form of metamorphosis is called **Incomplete Metamorphosis.** Here the insect grows from an egg to a nymph that resembles the adult but is much smaller. It will grow and shed its skin several times (molts) until it molts for the last time to become an adult. Examples include, dragonflies, true bugs such as stinkbugs, cockroaches, aphids, cicadas. Grasshoppers and praying mantids are also included in this type of metamorphosis. Typically, the nymphs and adults eat the same foods.





Integrated Pest Management (IPM)

A pest is any organism that is a nuisance, harms or damages us, our food crops, homes, or animals.

Can you think of some pests that affect you? _____

Can a plant be a pest? _____

Can you name a plant pest? _____

How is it a pest? _____

There are a number of ways to get rid of pests. We can use chemical compounds that kill pests. These are called **pesticides**. If a pesticide kills an insect, it would be called an **insecticide**.
If a chemical kills plants, what would it be called? (Hint: Plants are often called "herbs".) _____

Many pesticides are harmful to living things other than the "pest" that we want to kill. Many of these chemicals can hurt us as well. Therefore we use only "**organic"** methods to grow our plants.

There is another way to get rid of pests that might not harm us or our environment. It is called **Integrated Pest Management,** or **IPM**. How can we control pests in ways that do not hurt us or the environment?

We need to understand that pests also have pests. With the IPM method of pest control we take advantage of the pests that harm the pests that we would like to kill. If we want to get rid of the cabbage worms that are eating our cabbage we could use a product called BT. BT is a bacterium that infects caterpillars and makes them sick and die.

Is BT safe to use in our butterfly gardens? _____ Why? _____

Lady beetles eat many small insects. We can use them to eat aphids and other small insects that eat our plants.
Spiders and wasps also eat many pest insects. Wasps and spiders could also hurt us.

Should we kill all spiders and wasps? _____

Why? _____

Mosquitoes are a big nuisance and can carry diseases like West Nile. Female mosquitoes need blood of a mammal to lay their eggs. When they bite us, we itch. They lay their eggs in water where their larvae can live until they become adult mosquitoes. Another bacterium related to BT can infect mosquito larvae and kill them. We can buy these in a dry form called Mosquito Dunks. There is also a mosquito that eats other mosquitoes.
What IPM methods could we use to reduce the number of mosquitoes around our homes and gardens?

_____

Is poison ivy a pest to us? The seeds of poison ivy feed 23 different kinds of birds.

Should we kill all poison ivy? _____Why?_____

Healthy plants, just like healthy people are usually able to fight off diseases.
Name at least 3 things plants, which are living organisms, need to stay healthy.

_____

_____

_____

Using IPM methods of pest control will keep our environment and people healthier!

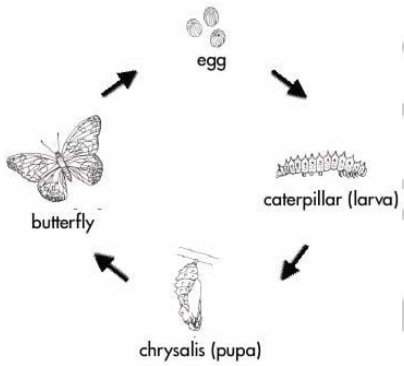
Native Butterflies & Host Plants

We are incredibly lucky to have so many butterfly species native to our area here in Southeast Texas. Texas actually has the most recorded butterfly species in the United States – over 400 have been documented here! This is a list of some butterflies commonly seen in our area and host plants you can include in your garden to attract them. All the ones listed have been spotted at Oak Forest!

Eastern Tiger Swallowtail: Green & White Ash, Prunus varieties, Tulip Magnolia
Spicebush Swallowtail: Spicebush, Camphor, Sassafras
Eastern Giant Swallowtail: Various Citrus varieties, Rue, Hercules Club, Prickly Ash, Hop Tree
Eastern Black Swallowtail: Dill, Rue, Fennel, Parsley, Queen Anne's Lace, Carrot Tops
Pipevine Swallowtail: Various Pipevine varieties
Gulf Fritillary: Various Passionvine varieties
Variegated Fritillary: Various Passionvine varieties, Violets, Pansies, Purslane, Flax
Monarch: Various Milkweed varieties
American Lady: Cudweed, Ironweed, Aster, & Pearly Everlasting
Tawny Emperor: Hackberry
Question Mark: Hackberry, Elm, Nettle
Viceroy: Willow, Cottonwood, Cherry
American Snout: Hackberry
Painted Lady: Sunflowers, Asters, Rudbeckia, Mallow, & Liatris
Cloudless Sulphur: Senna, Partridge Pea

Butterfly Lifecycle

All butterfly species go through a **four-stage lifecycle** called **complete metamorphosis**: egg, larva, pupa, and adult. They are susceptible to many predators in all four of these stages.



Egg: Their eggs are left on the **host plants** that the caterpillars will consume. It is important for the female butterfly to find the correct plant on which to lay her eggs for the caterpillars to survive.

Larva: Caterpillars, also called larva, go through 5 stages, or instars. Caterpillars will spend most of their time eating and growing. Occasionally, they will pause in their eating to molt between each instar. **Molting**, the shedding of their old skin, is necessary because their skin cannot stretch. The final molt is when they change from a caterpillar to a pupa.

Pupa: The pupa or chrysalis stage occurs when the former caterpillar transforms into a butterfly. The time frame for this change is different for each species, but it's generally around 2-4 weeks. Many species have camouflage in this stage to help them blend into their surroundings to avoid predators. This is an example of a butterfly's **adaptation**. Others have the ability to move while in chrysalis, something that can startle potential predators.

Adult: Once the pupa has completed its change, an adult butterfly will emerge from the chrysalis. After emerging, the butterfly will pump a green fluid called hemolymph from their abdomen into their wing veins. They will hang for about 2-4 hours to allow their wings to straighten and harden, then they will be ready to fly away and start the 4-stage lifecycle or complete metamorphosis all over again!

Important note: It is exciting to see the butterfly lifecycle happen in the garden but remember to avoid picking up any caterpillars you are not familiar with. Some of our native caterpillar species can inflict painful stings.

Butterfly Gardening

"Living is not enough, said the butterfly. One must have sunshine, freedom and a little flower." Hans Christian Andersen

We plant flowers in many areas of the Oak Forest campus to attract pollinators and, very specifically, butterflies. Oak Forest is a member of Monarch Watch, an organization that tries to preserve the Monarch butterfly. You will find plants that attract butterflies in the beds in front of the school and the portable buildings and around the vegetable gardens. Note: the construction caused the main butterfly bed by the portables to be removed. We hope it will be restored after construction.

You can plant a garden for butterflies at home by keeping the following things in mind and checking out the butterfly gardens around the school. Often during the school year we will find "volunteer" plants in the vegetable garden that we transplant for students to take home.

LOCATE your butterfly garden in a sunny area. Butterflies and most butterfly-attracting plants need lots of sunshine.

PLANT nectar-producing flowers. Butterflies visit flowers to find nectar, a sugary fluid, to eat. Many native butterflies seem to prefer purple, yellow, orange, and red blossoms. Clusters of short, tubular flowers or flat-topped blossoms provide the ideal shapes for butterflies to easily land and feed. Native plants are the best ones to use. Plant flowers that bloom throughout the growing season. Butterflies are active from early spring through late fall and sometimes even into the winter.

USE large splashes of color in your garden beds. Butterflies are first attracted to flowers by their color. Groups of flowers are easier for butterflies to locate than isolated plants.

SELECT flowers that have single petals rather than double rows petals. The nectar of single flowers is more accessible to butterflies and easier for them to extract than the nectar of double flowers, which have more petals per flower.

INCLUDE host plants in the garden. Host plants provide food for caterpillars, which need different plants for food than the adult butterflies. Female butterflies find these plants in the garden and lay their eggs on them.

INCLUDE damp areas or shallow puddles in the garden. Some butterflies drink and extract salts from moist soil. Occasionally large numbers of male butterflies congregate around a moist area to drink, forming a puddle club.

DO NOT use pesticides in or near a butterfly gardens. Most of the usual garden pesticides are toxic to butterflies and their caterpillars. Use predatory insects specific for pests and insecticidal soap directly on pests, or remove pests by hand if problems occur.

BECOME a butterfly watcher. Butterflies are easy to identify using field guides. Read the butterfly signs around the gardens at school to learn more about butterflies and the plants that attract them at Oak Forest.

What types of flowers attract butterflies? _____

Where should you plant a butterfly garden? _____

Should you use insecticides in your garden? _____

Why? _____

What is a host plant? _____

Can you name the host plant for the monarch butterfly? _____

Butterflies go through how many instars? _____

Why should we encourage butterflies in our gardens? _____

_____

Fruit Growing on Campus

Nutritional Components of Fruits in General
Carbohydrates
Water
Vitamins A and C

A wide assortment of fruit trees, vines and bushes have been planted around the campus for demonstration purposes in the 5th grade gardening program. Many of the trees and vines grow near raised beds of vegetables in an orchard on the east side of the schoolyard. Fruits from there that are not sent home with the students or made into preserves to support the volunteer gardening program feed the wildlife around the school. Similarly, grape vines grow up a long fence beside the main vegetable garden and banana trees grow near a corner of the little red shed. Varieties of fruits we have chosen to grow here tend to be hardy enough to need little or no care such as spraying for diseases and pests.

Banana: We grow a variety of banana called 'Grand Nain'. When the large trunks overwinter without freezing, the stalks will bloom and have fruit the next growing season. A bloom stalk is quite spectacular and if pollinated may form small bananas. We may harvest the stalk of bananas before freezing weather arrives and let the bananas ripen indoors. They are sweeter than those bought in grocery stores.

Citrus: Various citrus trees are grown around campus. The orchard had grapefruit, lemon, kumquat, satsuma, mandarin, navel, and 'Republic of Texas' orange trees, including the 'Improved Meyer' lemon, which yields lemons larger and sweeter than commercial lemons. **Many of the school's citrus trees were killed by the hard freeze in February of 2021**. A Meyer lemon tree has been replanted next to the compost bins by the shed, and other citrus trees will also be replanted. We will not have any fruit to harvest from these new trees for several years to come. The leaves of the citrus trees serve as food sources for the caterpillars of the Giant Swallowtail butterfly.

Fig: Figs are easy fruits to grow. We have sweet varieties called 'Celeste' and 'Brown Turkey'. When these figs are ripe, they turn a dark purple-brown color. They are fast growing. Think "Fig Newtons" if you have not actually tasted a fig.

Grape: Along the perimeter of the vegetable garden, we have vines of muscadine grapes. There are mustang grapes and another type of muscadine grape growing in the orchard. These grapes are easy to grow and are great for juice and jelly. They are not what are called table grapes like the ones you find in stores meant for fresh eating.

Pear: Pears like we buy at a store are difficult to grow here. The ones in our orchard are a 'Warren', an 'Acres Home' and 'Biscamp' pear. They are hard pears that are not great eating but make great preserves. All ripen in summer. The raccoons love them, too!

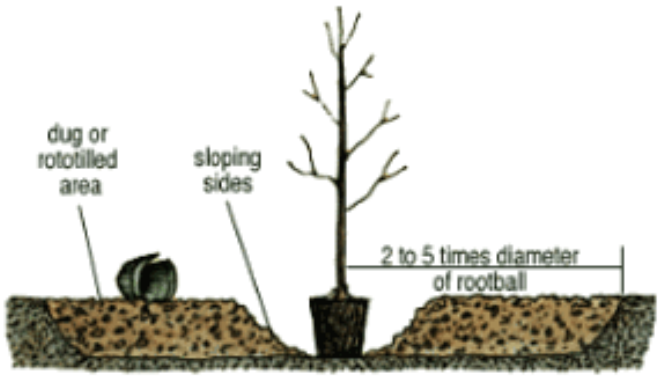
Persimmon: Persimmons have beautiful orange fruits in late fall. They are beautiful small trees. Their fruits are extremely sweet. You can eat the skin, too. The variety we grow is called 'Fuyu'. And it comes from the Orient. The opossums and raccoons love the persimmons.

Plum: We have several native Mexican plums in the natural areas as well as in the orchard. They are small fruits that make a tasty jam. Raccoons and opossums love the fruit. Plums are referred to as a stone fruit.

Many of our citrus trees froze during the hard freeze in 2021. We are replanting as money and time allows. In 2020 we harvested over 1000 pounds of citrus.

Planting a Containerized Tree

November through February are the best months to plant trees in the Lake Houston area. The official Texas Arbor Day is the first Friday in November.



Fifth Graders at Oak Forest plant an Oak tree each year as a going away gift to the school. Students are encouraged to earn or save $4 during the year as their contribution to this tradition. Planting is usually in February.

This year we are planting a _____

_____tree.

If a tree is planted correctly, it has the potential to grow twice as fast and live at least twice as long as one that is incorrectly planted.

Prepare the tree by trimming off any broken or lower branches. Do not cut off the top of the tree and you should never prune more than 1/3 of the branch area.

Dig Safely—Watch for sprinkler lines, telephone and power lines.

Prior to digging it is important to scrape off all grass or sod on the surface including the roots of the grass and discard this in the compost heap or away from the digging site.

Dig a hole as deep as the height of the container of the tree, and approximately 5 times the width of the container. The loosened and prepared soil will encourage root growth beyond the current root ball and will result in a healthier tree. An easy way to measure and mark this is with a water hose outlining the circle you will dig. Cover remaining grass with plastic before piling soil on it.

Keep the soil around the roots when transplanting. Always handle your tree by the ball or the container, not by the trunk or branches. Don't let the root ball dry out. Help prevent root girdling by vertically cutting any roots that show tendencies to circle the root ball.

After placing the tree and making sure it is fairly level, place soil firmly but not tightly around the root ball. It is best to use the soil that came out of the hole to plant the tree. For a very large hole it is OK to mix in a bag or two of potting soil or compost. If the soil is dry, water before and while closing the hole to make sure water is around the roots.

Place a protective 3-5-foot circle of mulch around the tree in a ‘donut’ shape so that water will sink down around the roots and not just run off and away from the tree. Mulch should not cover the trunk above the soil line. Do not fertilize until the beginning of the next spring.

Make certain that the tree gets a 5-gallon bucket of water every week for the first year.

It should be fertilized each spring, pruned, if necessary, weeds and grass should be removed back to the original mulch line, and new mulch spread around the base.

In December students plant an individual acorn which will grow into a small oak tree they can take home.

Harvest Celebration and Favorite Recipes

In the past, at the end of every gardening year we have a **Harvest Celebration**. OFE volunteers make many dishes for this celebration using produce from the gardens. Students also make their own individual English muffin pizza with cheese, pepperoni, fresh herbs, and chopped vegetables. Raw vegetables are cut up and served with ranch dressing. Lemonade is made largely with juice from the school lemon trees and is offered with mint leaves. Each classroom eats together following a set schedule. The total weight of all the produce grown this year is announced. Harvest celebration is always a fun time for everyone. We look forward to it all year!

Volunteers use various recipes for student favorites such as **roasted rosemary potatoes, Texas squash casserole, coleslaw, zucchini bread, basil lime cookies, carrot cake, lemon crinkle cookies,** and **salsa verde.** Some of the favorite recipes are included here as many students ask for them at the celebration. Try making these recipes when you bring produce home from the garden. A large part of gardening is eating what you grow. Because we use only organic growing methods and the produce is fresh when you take it home, you will eat healthier and tastier food.

Basil Lime Cookies
Yield: 3 dozen
Ingredients:
2 cups all-purpose flour
1 ½ teaspoon baking powder
½ teaspoon salt
2/3 cup softened butter
1 cup sugar
1 teaspoon vanilla extract
1 egg
3 tablespoon fresh chopped cinnamon basil
½ teaspoon lime oil or 1 tablespoon lime zest
1 cup chopped pecans

Directions:
Sift the 1st three ingredients together; set aside.
In a large mixing bowl, beat butter at medium speed until light.
Gradually beat in sugar; add egg, vanilla, basil, and lime, beating until light and fluffy.
At low speed, beat in dry ingredients in 3 to 4 additions.
Mix in chopped pecans.
Turn dough out onto lightly floured surface; divide in half.
Shape each half into a roll 6 to 7 inches long.
Roll in plastic wrap. Refrigerate until firm at least 8 hours.
(Dough may be frozen and afterwards thawed in refrigerator before baking.)
Preheat oven to 375 degrees. Cut dough into 1/8 -inch slices and place 2 inches apart on ungreased cookie sheet. Bake 8 to 10 minutes until lightly brown. Remove cookies with a spatula and cool on a wire rack.

Lemon Crinkle Cookies
Yield: *2-3 dozen*
Ingredients:

½ cups butter, softened
1 cup granulated sugar
½ teaspoons vanilla extract
1 whole egg
1 teaspoon lemon zest
1 Tablespoon fresh lemon juice
¼ teaspoons salt
¼ teaspoons baking powder
⅛ teaspoons baking soda
1½ cup all-purpose flour
½ cups powdered sugar

Directions: Preheat oven to 350 degrees. Grease light-colored baking sheets with nonstick cooking spray and set aside.

In a large bowl cream butter and sugar together until light and fluffy. Whip in vanilla, egg, lemon zest, and juice. Scrape sides and mix again. Stir in all dry ingredients slowly until just combined, excluding the powdered sugar. Scrape sides of bowl and mix again briefly. Pour powdered sugar onto a large plate. Roll a heaping teaspoon of dough into a ball and roll in powdered sugar. Place on baking sheet and repeat with remaining dough.

Bake for 9 to11 minutes or until bottoms begin to barely brown and cookies look matte {not melty or shiny}. Remove from oven and cool cookies about 3 minutes before transferring to cooling rack.

*If using a nonstick darker baking tray, reduce baking time by about 2 minutes.

Favorite Recipes, continued

Mrs. McMullen's Zucchini Bread

3 eggs
1 cup vegetable oil
2 cups sugar
1 tablespoon vanilla
2 teaspoon cinnamon
1 teaspoon. salt
1 teaspoon baking soda
3 cups unsifted flour
1/4 teaspoon baking powder
2 cups raw grated zucchini
1 cup chopped nuts or raisins (optional)

Beat eggs until frothy. Beat in oil, sugar, and vanilla until thick and lemon-colored. Stir in zucchini, cinnamon, salt, baking soda, and baking powder. Fold in flour. Add nuts if desired. Grease and flour 2 large bread pans. Bake at 350 degrees for 1 hour.
Cool 10 minutes before taking out of the baking pans.

Mrs. Opperman's Carrot Cake
2 cups flour
2 teaspoon baking powder
1 teaspoon baking soda
1 teaspoon salt
2 teaspoon cinnamon
1 ¼ cups salad oil
2 cups sugar
4 eggs
2 ½ cups of finely grated carrots
1 cup chopped pecans
Sift together flour, baking powder, soda, salt, and cinnamon. Combine oil and sugar, add half the flour mixture, blend, add remaining flour mixture alternately with eggs, and add carrots and pecans mix well. Grease and flour a 9 X 13 inch pan **or** 3 nine inch round cake pans. Bake in oven at 350 degrees 40 to 45 minutes, or until toothpick inserted in middle of cake comes out clean. Allow cake to cool on rack before icing.
Icing:
½ cup butter, room temperature
1 package of cream cheese (8 oz), room temp.
1 pound confectioner's sugar or more if needed
1 teaspoon vanilla
Beat in mixer until smooth. Spread on cooled cake.

Mrs. Sanders' Rosemary Roasted Potatoes
Small red potatoes
Olive oil
Rosemary leaves, chopped
Salt and pepper, to taste

Wash and quarter potatoes. Coat them with olive oil and chopped rosemary leaves. Add salt and pepper to taste. Bake in a 350 degree oven 30 minutes or until done.

Mrs. Opperman's Texas Zucchini Cheese Bake
4 eggs, beaten
½ cup cooking oil
1 cup biscuit mix
½ teaspoon salt
½ teaspoon Italian seasoning
¼ cup chopped onion
2 tablespoon chopped parsley
1 cup grated sharp cheddar cheese
3 cups thinly sliced zucchini or yellow summer squash
Save back ¼ cup of the cheese to sprinkle on top before baking. Mix the remaining ingredients together thoroughly and pour into a greased 9 x 11 inch baking dish. Bake at 350 degrees 25 minutes or until bubbly and browned around the edges. Serve cut into squares while warm. However, it is good at room temperature as well.

Mrs. Vega's Salsa Verde
1 ½ pounds tomatillos
½ cup chopped white onion
½ cup cilantro leaves
1 tablespoon fresh lime juice
½ teaspoon sugar
2 jalapeno peppers stemmed, seeded, and chopped
Salt to taste.
Remove papery husks from tomatillos and rinse well. Place tomatillos in a saucepan and cover with water. Bring to a boil and simmer 5 minutes. Remove tomatillos with a slotted spoon. Place all ingredients in a food processor or blender and pulse until all ingredients are finely chopped and mixed. Adjust seasonings to taste. Cool in refrigerator.

Urban Harvest Herb Cream Cheese Spread
8 ounces cream cheese at room temperature
Freshly chopped herbs in favorite combinations like garlic chives, oregano, and rosemary; onion chives and dill; or basil, oregano, and rosemary.
Blend herbs into cream cheese. Salt and pepper to taste. Store in refrigerator to blend flavors. Spread on your favorite crackers and enjoy!

Growers' English Muffin Pizza
Spread a split Thomas' English muffin with your favorite pizza sauce, followed by shredded mozzarella cheese. Place your favorite toppings on the cheese. Bake muffins at 450 degrees 5 to 10 minutes or until the cheese is bubbly and slightly browned.
Makes a great lunch or snack!

You Are What You Eat

Nutritional Components of Vegetables and Fruits at OFE

There are six groups of nutrients vital to humans: water, minerals, vitamins, carbohydrates, fats and proteins. Nutrients provide energy and other substances the body needs. Most of the nutrients in the food fall into three major groups: proteins, fats and carbohydrates.

Proteins help the body build and repair tissue; provides energy; regulates body functions; helps transport nutrients and oxygen. A vegetable such as spinach, potato or broccoli are a good source of protein.

Fats are used by the body as a fuel source and fat is the major STORAGE form of energy in the body.

Carbohydrates are the body's main source of energy, aids with digestion. Fruits and vegetables are excellent choices because they also contain vitamins, minerals, water, and other nutrients.

Water helps with digestion, lubrication of bones and joints, and regulation of body temperature.

Minerals

Calcium	Needed for strong bones. It also helps with blood clotting, muscle use, and nerve functions.
Iron	Important for hemoglobin, the protein that carries oxygen in the blood.
Magnesium	helps regulate temperature and the nervous system and muscles. It also helps the body use carbohydrates, fats, and proteins.
Potassium	Regulates body fluids, the nervous system, muscle functions, and nutrient absorption.
Sodium	Regulates body fluids, the nervous system, muscle functions, and nutrient absorption.

Vitamins

Vitamin A	Helps with night and color vision, growth of bones and teeth, and production of healthy skin
Vitamin B2	(riboflavin) Helps the body use carbohydrates
Vitamin B3	(niacin) Important to the nervous system and digestive tract
Vitamin B5	(pantothenic acid) Helps the body use fat; helps in production of hormones and cholesterol
Vitamin B6	(pyridoxine) Helps nervous system function; maintains healthy skin and red blood cells
Vitamin B7	(biotin) Helps the body use carbohydrates, fats, and proteins
Vitamin B9	(folate) Helps with production of red blood cells
Vitamin C	Helps fight infection and heal wounds. It also helps the body to absorb iron and calcium.
Vitamin E	Helps protect cells and tissues and keep them strong
Vitamin K	Needed for blood clotting

Three Sisters Garden

The "Three Sisters" were the three main food crops grown by various Native American groups of people. A three sisters garden includes squash or pumpkins, corn and climbing beans. Although many different Native American people have adopted this traditional gardening technique, it is said to have originated with the Haudenosaunee or "People of the Longhouse" who were the ancestors of the Iroquois Indians. The legend of the Three Sisters varies from tribe to tribe.

Corn or maize, squash, and beans all originated in the Americas. Native people as far back as ten thousand years ago cultivated squash. Cultivating wild plants is called domesticating them. Corn came next and beans were domesticated last. Those early forms of these plants were not those that we know today. All three crops were ones that could be stored well for use in winter. These three crops eaten together are very nutritional. This plant-based diet provides nutrients to keep people healthy.

The traditional "Three Sisters" garden forms a community of plants. Each plant helps the others grow, in other words, each crop benefits from the others growing nearby. This is a form of gardening called **companion planting.** The corn (Poaceae) provides a structure for the beans to climb. The beans, being part of the Legume family (Fabaceae), provide nitrogen (N) to the soil that the other plants use to grow. The squash (Cucurbitaceae) spreads along the ground to help keep moisture in the soil and keep it cooler in the summer, acting as living mulch. The prickly squash leaves also keep certain pests away from the other plants.

How to plant a "Three Sisters" garden: Build a mound of soil about one foot high and about 18 inches to 3 feet wide. Each mound should be about 3 to 4 feet apart. Plant corn 4 to7 corn seeds about 6 inches apart in the center of each mound. These need to be thinned to 3 to 4 seedlings. Many Native people honor a tradition of giving thanks to the "Four Directions" by placing the corn seeds in a north, south, east and west facing position. After a week or two, when the corn seedlings are about 4 inches high, soak and then plant 4 pole beans seeds in a circle about 6 inches away from the corn. The bean seedlings should be thinned to 3 or 4 seedlings. Soon after planting the beans, plant 4 squash or pumpkin seeds next to the mound, about 1 foot away from the beans. Thin the squash to 1 seedling. If a large area is planted, the squash can be planted in separate mounds, 1 foot in diameter, between every few corn and bean mounds.

Organic Products Used in the Oak Forest Gardens

The Growers at Oak Forest have been using organic products and methods in the vegetable gardens for over 15 years. Our results in producing over a ton of fruits and vegetables each year prove that these methods work. The advantages to using organics instead of more widely sold and used synthetic chemical alternatives are many. Unfortunately, due to fewer sales of organic products, often they are more expensive in the short run. We believe the long-range benefits are worth the extra price you may have to pay initially. Also remember, if you have been using synthetic chemicals in your yard or garden for many years, organic products and practices won't turn those bad practices around instantly. It will take time and persistence to achieve the benefits of going organic.

Most organic fertilizers are not as concentrated as synthetic chemical fertilizers. Always read the label directions and do not use more than the label recommends. This is even more important for chemical fertilizers if you continue to use them.

The organic products we use: (Remember, there are other good organic alternatives)

MicroLife Products	Many different products, all are high quality. Our go-to fertilizer is their 6-2-4 Their humates also add valuable microorganisms to your soil. Their web site shows all their products: https://www.microlifefertilizer.com/
Cotton Seed Meal	A great powdered fertilizer especially for tomato and pepper plants
20% Horticultural vinegar	An alternative to synthetic herbicides. Kills weeds and grass
Orange Oil	Used to kill mounds of fire ants (may also harm other soil creatures)
Molasses dry or Liquid	Molasses is a great fertilizer and discourages Fire Ants
BT	BT makes caterpillars sick but harms nothing else
Rock Phosphate	Great soil amendment for root crops especially onions
Liquid Fertilizers	Good liquid fertilizer for foliar feeding (Ocean Harvest and/or Super Seaweed) Max Bloom does what it says for more blooms
.	
Worm Castings	Wonderful all-around fertilizer, especially good in containers and pots

Soil ----When buying soil, remember cheap may not be good. Cheap bagged soil is usually poor quality. Since soil is the basis for healthy plants, buy the best that you can afford. Do not skimp here! We do not like soils with fertilizers included. It is better to know what fertilizer you are using.

Compost---We make most of our own compost from green waste generated in the gardens and supplemented by bulk materials we bring in. If you are buying compost, again, cheap usually means low quality. The best that we know of in the Houston area is made by **Nature's Way Resources**. It is available in bulk by going to their operations just south of Conroe or by the bag from local garden centers.

Mulch---We use mostly pine needles and mulched leaves to mulch many of our plants and trees. During the summer we use freshly cut grass around plants and vegetables. Know the source of your material. If it has been recently treated with an herbicide or pesticide the remnants of those products will leach into your soil. Do not use dyed mulches just because they are pretty. Many of them are dyed with toxic materials. Plain pine bark mulch, while used extensively in our area, does deplete the soil of nitrogen as it decomposes. Extra fertilizer may be needed.

Sources: These products are available elsewhere, however, recently they were available at these stores:

1) Atascocita and Kingwood Ace Hardware and Alspaugh's Hardware
2) Lowes of Atascocita and Home Depot
3) Kingwood Garden Center and Warrens Garden Center

The OFE Growers hold a fund raiser in January/February selling MicroLife products. Watch our web site for details. **www.ofegrowers.org**

The above suggestions are made from our experience in the school gardens. We imply nothing beyond this.

RAINWATER HARVESTING

Water quality can be a problem for gardeners. Organic gardeners depend on micro-organisms to provide nutrients necessary for healthy plants and healthy soil. People assume that **potable** water (tap or faucet water), or water considered safe to drink, would be the best choice of water for our gardens. **Potable** water is treated with chemicals to kill microorganisms in the water that are harmful for humans to consume. This treatment puts chemicals such as chlorine, fluorine, and sodium into the water to kill harmful bacteria in the water. These chemicals may kill the beneficial microorganisms needed for making compost and for feeding plants.

Rainwater is usually thought of as the most pure of all types of water. However, rainwater can dissolve many particles from the air. This rainwater, with dissolved particles, is called acid rain. Rainwater may also be contaminated from surfaces that it comes into contact with during its collection. As a result, untreated water collected for the garden is referred to as gray water. **Gray water** is considered safer for plants and, over time, less expensive than chemically treated water. As water pumped from underground aquifers or drawn from rivers and lakes becomes less plentiful, **gray water** is an increasingly important source of irrigation water.

Use of rainwater for gardening has become more affordable as more materials are available for rainwater harvesting systems. As a result, the organic gardens at Oak Forest Elementary School now have several rain harvesting systems in place. Our main collection system is a 250-gallon rainwater harvesting system attached to the gardening shed on the south side of the school building. Fifth graders use this water in the gardens as part of their gardening, science, and math lessons.

The system captures rain from the roof of the 10 foot x 12 foot garden shed, directing the water by gutters and pvc (polyvinyl chloride) pipe to a 250-gallon green plastic rainwater tank. (The color green reduces growth of algae inside the tank.) This system captures 74.8 gallons of rain water from a 1-inch rainfall. A 4-inch rain would overflow the tank. When a heavy rain occurs, an overflow pipe takes the extra water away from the tank area. A clear plastic tube allows students to view and record the amount of water in the tank. By recording water levels after a rain, students can keep track of how much water has been captured. This gray water is used only for growing plants and making compost and never as a drinking source.

We invite interested parents and community members to walk to the back of the school to look at this simple collection system. You may get ideas of how you, too, could capture rainwater from your roof. This system was designed and built by the volunteers led by Mr. Langridge.

Other Means of Collecting Rain Water at OFE:
(See next page.)

Rain Water Harvesting (continued)

Another method of collecting rainwater includes five-gallon buckets placed around the garden beds to collect any rainfall or excess sprinkler system water. Water is consolidated in the buckets and when a bucket is full, it is closed with a lid to keep mosquitoes from laying eggs inside. These food-grade buckets are recycled from the Tin Roof Barbeque restaurant. Water from these buckets is used to water individual plants in the garden.

Still another method to capture rainwater is used in the OFE gardens. A large clean plastic garbage can topped by a tight fitting screened lid makes a great rainwater collection and storage container. By slightly elevating the can and fitting the bottom of the can with a faucet and hose, water can be directed to individual plants or attached to a drip irrigation line. The trashcan has about a 50-gallon capacity. Students collect the water accumulated in the white buckets and pour it into these specially fitted trashcans. The garbage can rainwater collector in the orchard area was made by a Brownie Troop for the school several years ago. This too, is something that can be done at home with a connection to a downspout or under the swale in a roof line that directs a stream of water from the roof. Let your imagination run wild on other ways you can collect water. **Remember, rainwater is better than tap water for our plants and it is free!**

Calculation of water capture:

Pertinent Information: 10 foot x 12 foot shed roof; 1 gallon of water = 231 cubic inches
Calculation: (Volume of 1 inch of rain or rainfall):
120 inches x 144 inches x 1 inch = 17,280 cubic inches
Conversion of volume to gallons:
17,280 cubic inches of water / 231 cubic inches of water (per gallon) = 74.8 gallons of water collected from 1 inch of rainfall

Fun Calculations:

If we receive 48 inches of rain this year, theoretically how many times will the green tank fill**?**_____

How many five-gallon buckets will it take to fill the 50 gallon trash can? _____

If we added to the size of the shed roof and made it twice as large, how much more rain water would we get for each inch of rain?_____

If we have a hard rain and each of the forty white buckets in the garden filled to half full, how many gallons of water would we be able to harvest? _____

Glossary

A

ANNUAL - A plant that will complete its life cycle in one growing season.
ANTHER – The end part of the stamen in a flower that holds the pollen.
AROMATIC – Anything fragrant or having a noticeable and pleasant smell.

B

BENEFICIAL – Something that is helpful or has good results or effects.
BIENNIAL - A plant that will require two growing seasons to complete its life cycle. In the first year it has leaves. In the second year it has blooms and seeds.
BOTANICAL NAME - The Latin scientific name of a plant is its botanical name. There is only one botanical name per plant so if you want a specific variety, use it's botanical name so you get what you want.
BUD - The embryonic shoot on a stem, branch, or tuber. It is the beginning of a bloom.

C

CHLOROPHYLL - The green pigment in leaves. It will be dominant in the plant when present or healthy.
COLE CROPS - These are members of the cabbage family, Brassicaceae, like broccoli, cabbage, cauliflower, kale, collards, and kohlrabi.
COMMON NAME - The name by which plants are known by non-botanists
COMPLETE METAMORPHOSIS – Has four stages: egg, larva, pupa, and adult. In each stage the animal looks different than at all the other stages.
COMPOST - Compost is a term for decomposed organic matter such as what is left after a compost heap has degraded vegetable matter. (An excellent source of organic material for rebuilding and enriching soil)
CONSUMERS – Organisms in the food chain that eat plants (producers). Primary consumers eat plants and are called herbivores. Secondary consumers eat primary consumers and are called carnivores. Tertiary consumers eat both primary and secondary consumers.
CROSS POLLINATION - The transfer of pollen from the flower of one plant to the flower on a different plant. Many species require this to set seed.
CULINARY HERB - A plant that is grown for its strong flavor and used in cooking. The parts of the plant used are the leaves, flowers, or bulbs.

D

DECIDUOUS - These are plants that lose their leaves at the end of the growing season.
DECOMPOSERS – Organisms that cause any organic material to rot or break down by natural processes.
DETERMINATE – Tomato varieties that grow to a fixed mature size and ripen all their fruit in a short period of time. These are usually bush types of tomatoes that have larger fruit.

E

EDIBLE – Suitable or safe to eat
EROSION - The wearing-away of soil by the action of man, rain, or wind.
EVERGREEN - A plant that has leaves throughout the year.
EYE - An undeveloped growth bud (as in a potato) or the center of a flower

F

FAMILY - One genus or several genera which have a basically similar floral pattern make up a family.
FAUNA - All the animals that live in a particular area, time period, or environment
FERTILIZE (R) - Substance added to soil to provide additional nutrients for plants. May also be used to describe the pollination process flowers undergo with the help of bees and other insects. There are organic and chemical fertilizers.
FLORA – All the plants that live in a particular area, time period, or environment
FRUIT - Generally a fruit is the edible part of a plant that contains the seeds.
FULL SUN - Six hours or more, in the direct sun during the growing season of the year
FUNGICIDE - A chemical used to control diseases caused by fungi.

G

GERMINATION - This is the process by which a plant grows from a seed. It is the sprouting of a plant (seedling) from a seed
GRAY WATER - This is used water or rainwater that is not treated to be safe for human consumption, but is safe to use for watering plants.

GROWING SEASON - The period from the last frost date in spring to the first frost date in the fall during which time plants actively grow

H

HERB - A plant grown for its medicinal or flavoring qualities or its scented leaves. Also, a term used for non-woody plants. Another name for a plant that is not woody
HERBICIDE - Any chemical that will kill a plant
HOST PLANT – A plant upon which an organism (such as an insect) lodges and lives
HUMUS - This is the organic residue of decayed organic material in the soil - the end product of composting.

I

INCOMPLETE METAMORPHOSIS – The process by which an organism grows through three stages: egg, nymph, and adult.
INDETERMINATE - Being able to grow for an indefinite period. These are usually vining tomatoes that set fruit over a long period of time.
INORGANIC – Something that is made from or containing material that does not come from plants or animals.
INTERDEPENDENCY – Living things that are related in such a way to depend on or need each other for survival
INVASIVE - The ability of a plant to spread quickly and crowd out other plantings.
IPM (Integrated Pest Management) - A method by which gardeners can learn to manage and eradicate pests by choosing appropriate plants providing good growing conditions and minimizing pests rather than killing them with chemicals.

L

LEGUME - A plant whose roots form an association with special soil bacteria that can take in atmospheric nitrogen. A good example of this are beans, bluebonnets, and peas.
LICHEN - A combined growing condition of algae and fungus. It looks crusty and comes in many colors.
LOAM - Good quality soil that has even amounts of clay, sand, silt, and organic material present and is crumbly to the touch; loam is ideal for most gardening.

M

MACROORGANISMS - Small creatures that can be seen by the naked eye.
METAMORPHOSIS – Is a process of major physical changes that animals go through to become adults.
MICROORGANISMS (Microbes) - Animals and plants that are too small to be seen with the naked eye and can only be seen with a microscope
MULCH - Any loose, usually organic material used to cover the soil to hold in moisture, keep weeds from sprouting, and to keep the soil temperature more moderate. A good example is pine needles.

N

NATIVE - This refers to a plant or animal that grows and lives in the same habitat in which they originated. These plants or animals can be native to a continent, state, or region.
NECTAR - A sugar and water substance secreted by flowers that attracts pollinators like bees and hummingbirds searching for food
NITROGEN FIXING - The changing of atmospheric nitrogen by bacteria into an available and useful form for plants
NODE – The small round part on the stem of a plant where a leaf grows

O

ORGANIC - Fertilizers and chemicals that have been obtained from a source which is or has been alive. Also, the general term used for a type of gardening using no chemical or synthetic fertilizers or pesticides.

P

PERENNIAL - A plant which will live for three years or more under normal conditions.
POLLEN - The variously colored dust-like substance produced by the anthers in a flower
POLLINATOR – Any organism that transfers pollen from one flower to another. These include people, bees, moths, butterflies, bats, and any other insect that moves from plant to plant.
POTABLE – Water that is safe for humans to consume.

PROPAGATION - In gardening this refers to the many ways of starting new plants
PRUNING - Cutting leaves or branches off a plant to remove dead or diseased foliage or branches. Also used to control or direct growth, increase quality, or yield of flowers or fruit, and to ensure proper growth.

R

ROOT CROPS - Any vegetables whose roots are edible

S

SCIENTIFIC NAME - The internationally recognized Latin name of a plant that consists of two parts, the **genus** and the **species**
SEEDLING – A young plant grown from seed
SELF POLLINATION - The transfer of pollen from one flower to another flower on the same plant
SLIP- A part (sometimes a root, leaf, or bud) removed from a plant to propagate a new plant by rooting
SOIL AMENDMENT - Anything added to the soil to improve its condition
SOW – To plant seed
SPECIES - This is a group of plants that have common characteristics. It is a basic unit of plant classification.
STIGMA - This is the female part of the flower which receives the pollen.
SYMBIOSIS – A close relationship between two different kinds of organisms or living things.

T

TAP ROOT - The main root of a plant which grows vertically into the soil.
TEXTURE - How soil particles and organic matter stick together in soil. Good soil is crumbly or has good **tilth**.
THINNING - Picking out the crowded seedlings in any flower or vegetable bed, to make a better growing condition for the rest of the plants.
TILTH – The condition of soil that supports healthy plant growth
TRANSPLANT – To remove a plant from the ground or from a container and move it to another place in a garden

V

VEGETABLE - A vegetable may be the edible stems, leaves, and/or roots of a food plant.

W

WEATHERING – Describes the breaking down or dissolving of rocks and minerals on the surface of the earth.
WEED – A plant that grows where it is not wanted. These rob plants of nutrients and moisture.

Resources

Books:

How Does Your Garden Grow? Great Gardening for Green-Fingered Kids by Clare Matthews

101 Kid-Friendly Plants: Fun Plants and Family Garden Projects by Cindy Krezel

Plant Experiments: What Affects Plant Growth? (Look at Life Science) by Mary Ann Hoffman

Roots, Shoots, Buckets & Boots: Gardening Together with Children by Sharon Lovejoy

The Gardening Book by Jane Bull

Better Homes and Gardens New Junior Garden Book by Felder Rushing

Guide to Kids' Gardening, National Gardening Association

The Southern Kitchen Garden by William D. Adams and Thomas R. LeRoy

A Garden Book for Houston by Lynn M. Herbert

Urban Harvest's **Year-Round Vegetables, Fruits, and Flowers for Metro Houston**, by Bob Randall, PhD.

Texas Organic Vegetable Gardening by J. Howard Garrett and C. Malcolm Beck

Let It Rot! by Stu Campbell

Texas Insects by Bastiaan M. Drees, Ph.D. and John A. Jackman, Ph.D.

Insects of Texas by David H. Kattes

Butterflies of Houston by John and Gloria Tveten

Field Guide to Birds of North America, National Geographic Society

A Field Guide to Texas Snakes by Alan Tennant,

Habitat Gardening for Houston and Southeast Texas by Mark and Mary Bowen

Gardening Lab for Kids: 52 Fun Experiments to Learn, Grow, Harvest, Make, Play, and Enjoy Your Garden
By Renata Fossen Brown

Internet Resources:

www.aggie-horticulture.tamu.edu **www.kidsgardening.org** **www.floridata.com** **www.wild-flower.org** **http://organiclifestyles.tamu.edu** **www.urbanharvest.org** **www.jmg-kids.us** **www.chron.com/HoustonGardening** **http://citybugs.tamu.edu** **www.soiltesting.tamu.edu** **http://harris.agrilife.org** **www.geography4kids.com** **https://www.hcpl.net/** **https://www.urbanharvest.org**

https://houstonpbs.pbslearningmedia.org/collection/thnkgard/

www.keepkingwoodgreen.org composting and recycling

Telephone Resources:

Harris County AgriLife Extension Office, **(713) 274-0950 (**for any local gardening information or questions).

Puzzle Fun

What vegetable can tie your stomach in knots? _____

"What does the letter "A" have in common with a flower? _____

What gets bigger the more you take away? _____

What do you call a mushroom that is the life of the party? _____

What do you call it when worms take over the world? _____

What kind of tree has hands? _____

Why did the tomato turn red?
_____

Why did the gardener plant his potatoes in paper bags?
_____

Why do potatoes make good detectives?_____

What kind of socks does a gardener wear?_____

What runs but never gets tired?_____

How do you stop moles from digging in your garden?
_____

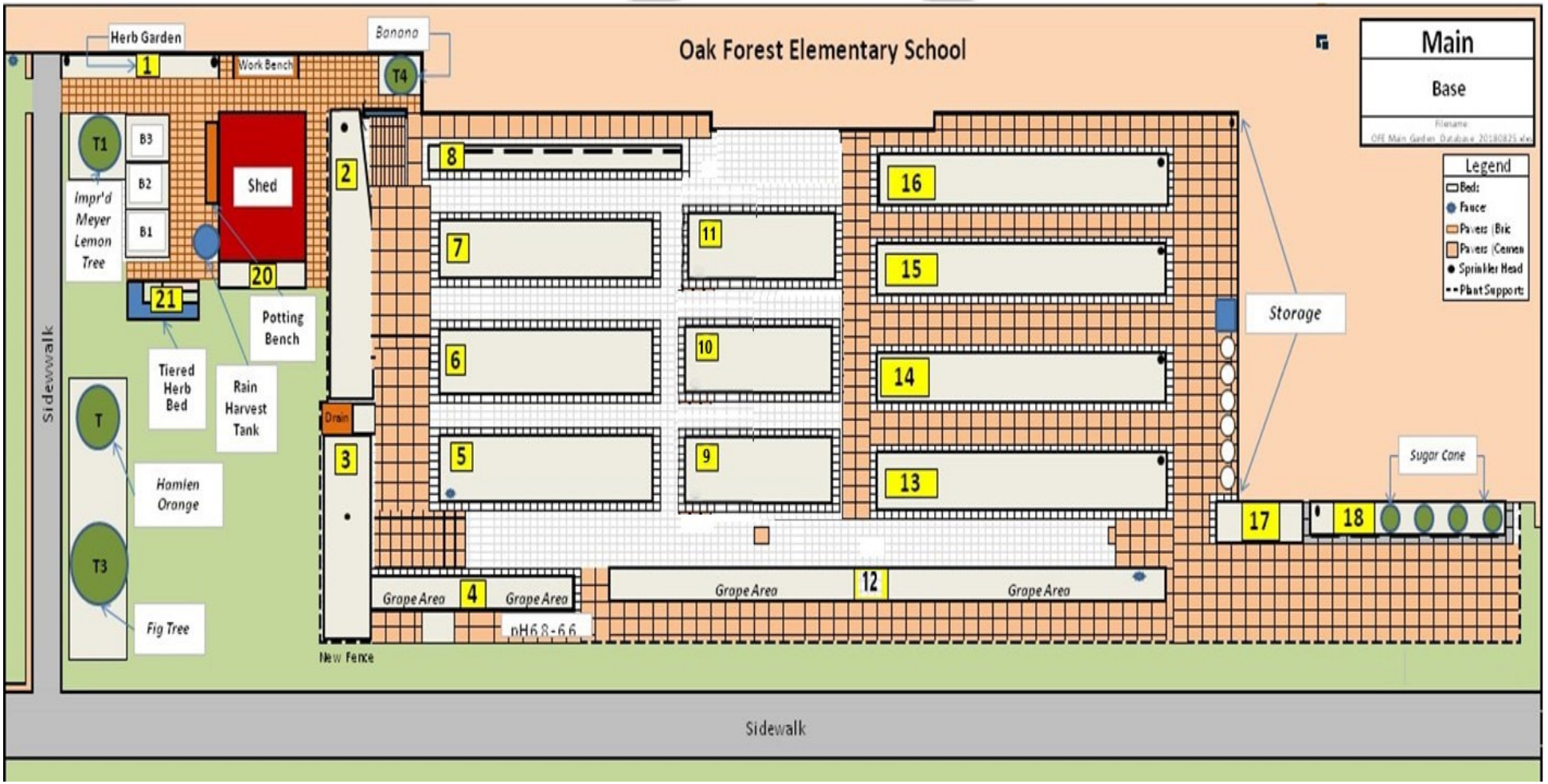
What is small, red and whispers? _____

Why did the banana go to the doctor?
_____

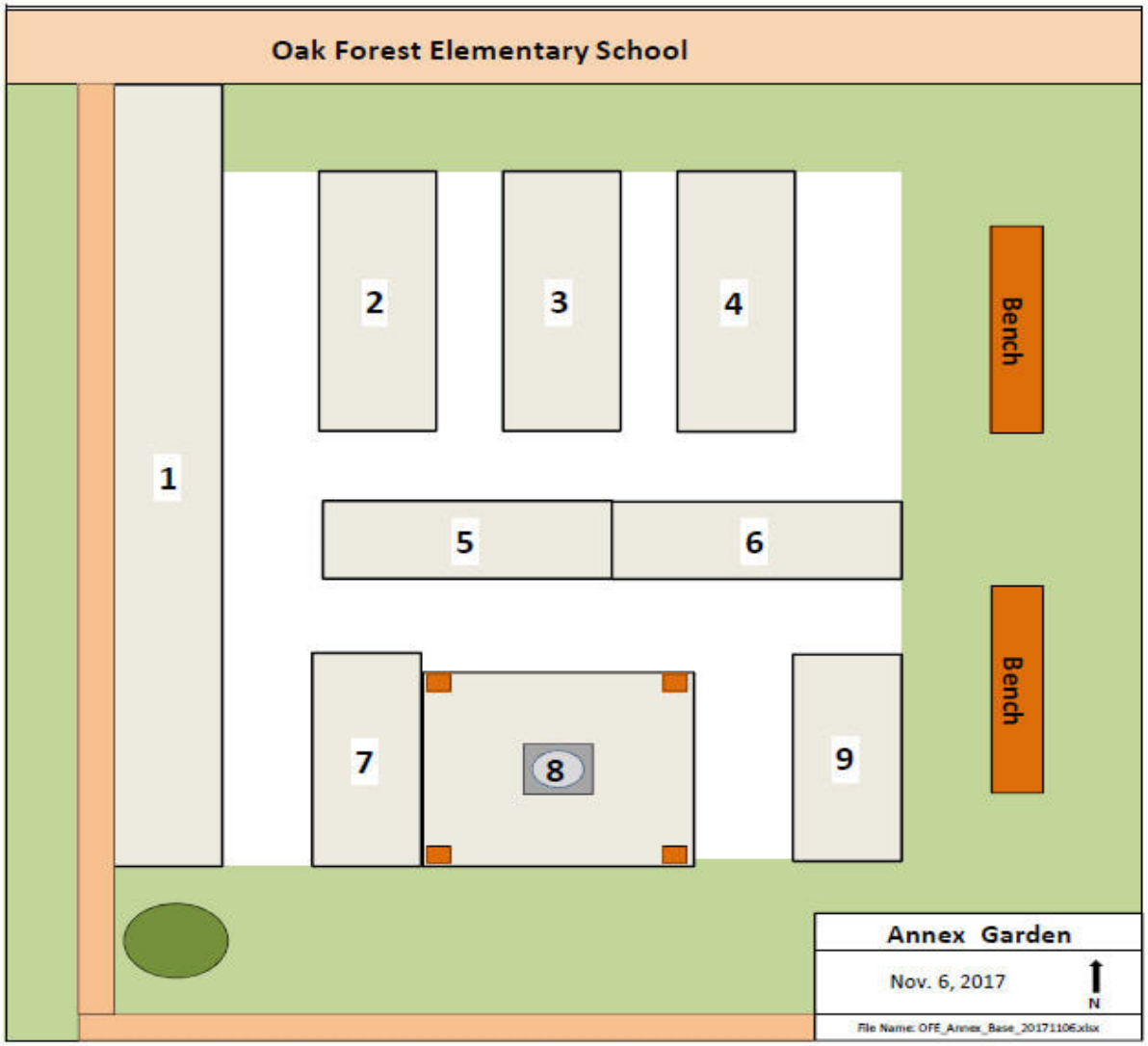
A Riddle:
There was a green house.
Inside the green house there was a white house
Inside the white house there was a red house.
Inside the red house there were lots of babies.
What am I?

(Answers found on the Growers web site, www.ofegrowers.org)

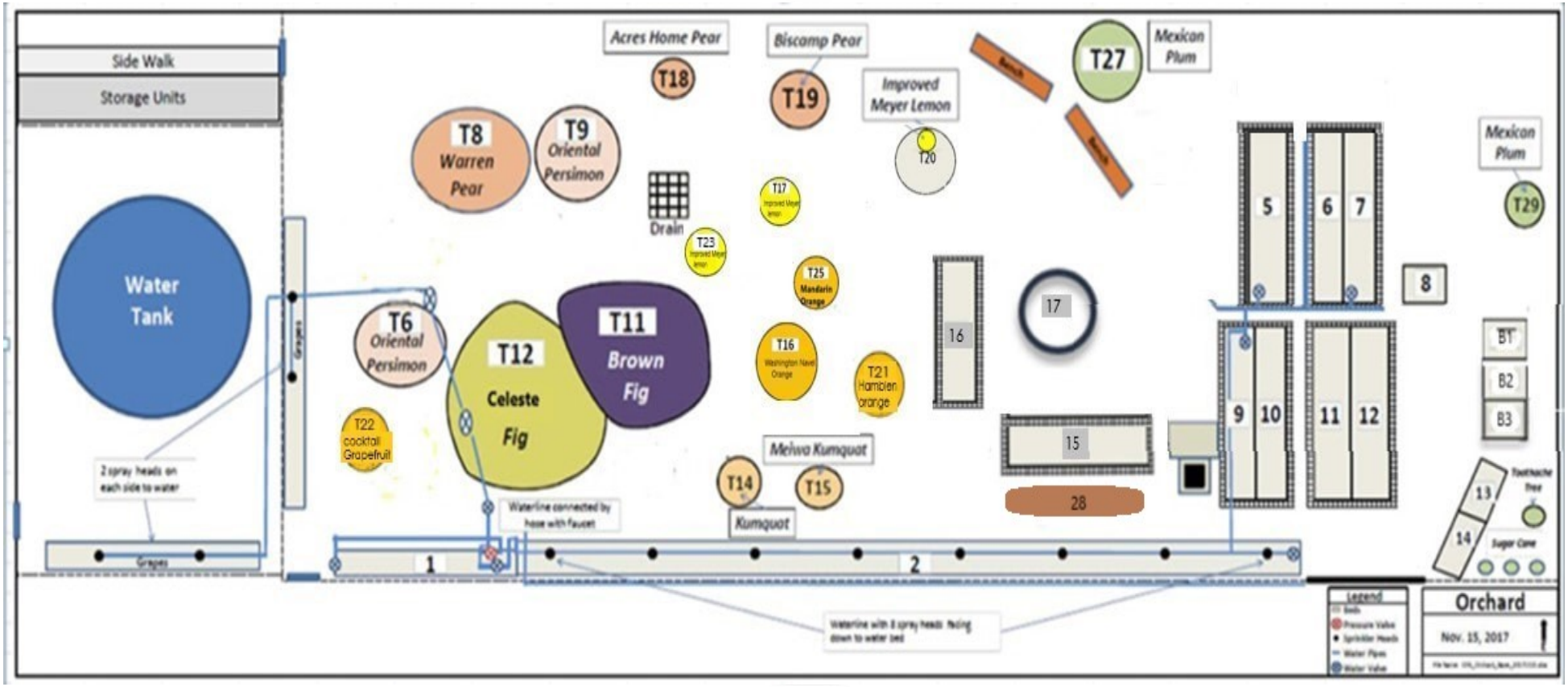
Main Garden Layout



Annex Garden Layout

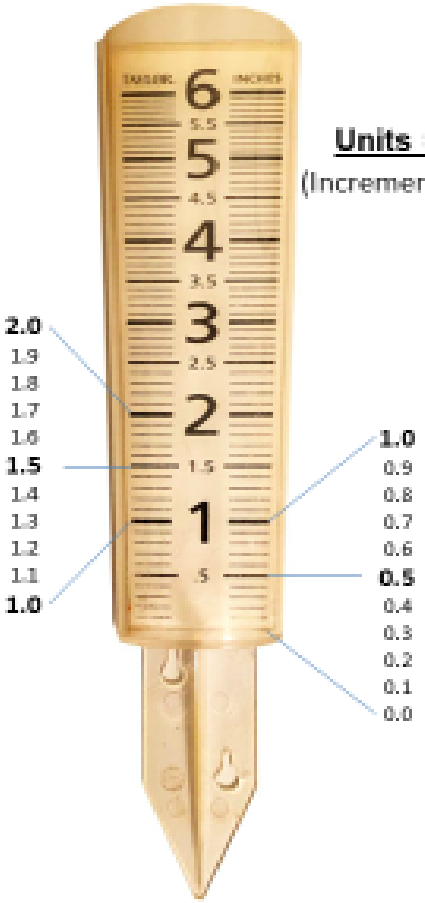


Orchard Layout



How to Read Gauges

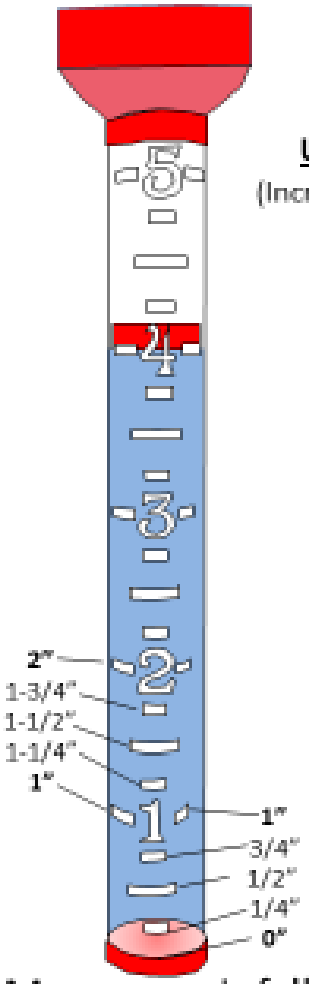
Rain Gauge



Units = Inches
(Increment of 0.1")

Measures rainfall near compost bins.

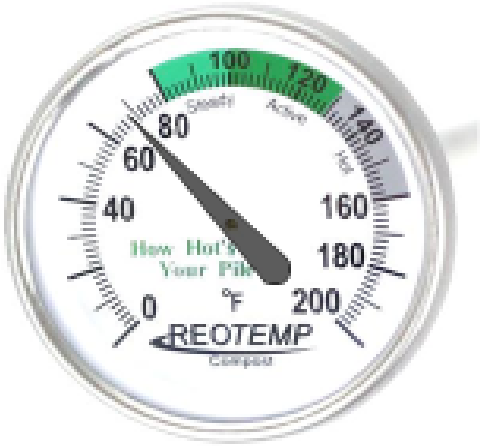
Rain Gauge



Units = Inches
(Increment of 1/4")

Measure rainfall in main garden.

Temperature Gauge

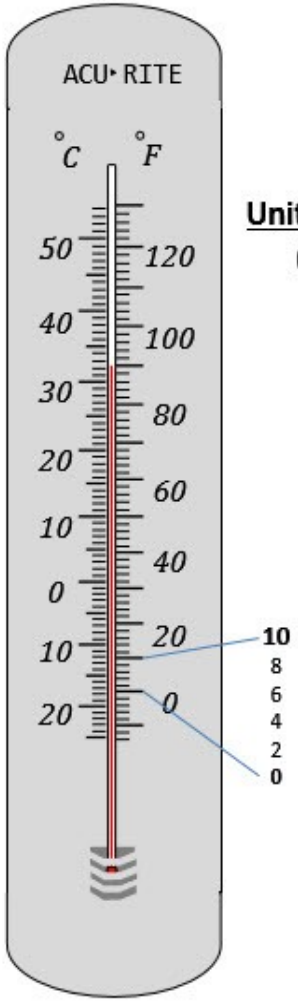


Units = Degrees
(Increment of 2 degrees)

Measures compost temperature.

How to Read Gauges

Temperature Gauge



Units = Degrees F

(Increment of 2 degrees)

Measures air temperature.

Scale (Weight)

Units = Pounds and Ounces

Do not use these 2 buttons

Measures weight of harvested produce.

Names of Tools to Know

Trowel

Weeder

Pruner/Clippers

Lopper

Scoop

Shovel (s)

4-Tine Cultivator

Hoe

Garden Fork

Garden Rake

Leaf Rake

Watering Can

Diffuser

Wheelbarrow

Garden Hose

Hose Nozzle

Ideal | marginal

Planting Chart for Lake Houston Area - Adapted for Oak Forest Elementary

Fruit / Vegetable	Sprout (days)	harvest (days)	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Beans (seed)	6-8	45-70												
Beets (seed)	8-12	50-60												
Brocolli (plant)	10-14	85-90												
Cabbage (plant)	12-14	85 -95												
Cauliflower (plant)	8-10	50-55												
Carrots (seed)	8-12	65-77												
Collards (seed)	8-12	65-75												
Corn (seed)	8-12	90 -110												
Cucumber (seed/plant)	5-10	55-65												
Eggplant (plant)	10-12	80-90												
Kale (seed)	10-14	40-50												
Kohlrabi (seed/plant)	8-12	50												
Lettuce (seed/plant)	8-12	40-80												
Muskmelon (seed/plant)	8-12	80												
Mustard (seed)	5-10	40-48												
Okra (seed/plant)	12-14	55-60												
Onion (set/plant)		60												
Pea, Sugar Snap (seed)	8-12	65-72												
Pea (seed)	8-12	55-65												
Pepper (plant)		60												
Potatoes, white (eye)		90-110												
Potatoes, sweet (set)		95-120												
Pumpkin (seed)	8-12	50-85												
Radish (seed)	5-10	50-60												
Spinach (seed)	8-12	28-45												
Squash (seed/plant)	7-10	50-60												
Swiss Chard (seed)	7-14	50-60												
Tomato (plant)	7-10	75-85												
Turnip (seed)	5-10	45-55												
Watermelon (seed)	6-8	80-90												

Note: Planting times are approximate and vary slightly from year to year.

http://www.ofegrowers.org

Memories of 5th Grade Gardening

2021 - 2022