Healthy Garden Soils

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http://osufacts.okstate.edu

The success or failure of gardening depends heavily on how gardeners prepare and use their soil, and on the amount of organic matter in the soil. Rich, productive garden soil does not usually happen by itself but can be achieved with plenty of effort and persistence. Improving the soil is an ongoing process if you desire healthy soil—and healthy soil is the very foundation of an Earth-Kind garden.

Methods of preparing or improving soil include the addition of organic matter, garden recycling and composting, fertilizing, and growing cover crops. All these can be part of an Earth-Kind system of using natural methods whenever possible to maintain and enhance a garden's ecosystem.

Some Helpful Definitions

Earth-Kind Gardening—a program that encourages non-chemical practices such as cultural, mechanical, botanical, and biological controls for garden pests.

Organic Gardening—a system of growing healthy plants by encouraging healthy soil, taking advantage of beneficial insects and birds, and using natural or organic fertilizers and pesticides. The term organic gardening has different meanings among different individuals, so a synthetically manufactured fertilizer or pesticide may be objectionable to one organic gardener but acceptable to another.

Integrated Pest Management—using a combination of techniques to reduce the quantity of pesticides needed in the garden.

Organic Matter—decaying plant and animal debris (including manure, compost, sawdust, roots, leaves, and grass clippings), which help to enrich and loosen the soil, improve drainage, hold water and nutrients, slow erosion, and provide a favorable environment for earthworms and beneficial microorganisms. In later stages of decay, organic matter releases nutrients to growing crops.

Cover Crops—plants that increase organic matter in the soil, aerate compacted soil, protect soil from erosion during fallow periods, and smother unwanted weeds. Cover crops are referred to as "green manure crops" when planted specifically to increase the organic matter in the soil. They are called cover crops when planted to protect the soil from erosion. Some crops are used for both purposes. Green manure crops generally are planted in the fall and tilled in the following spring, but there are some warm-season green manure crops grown during the spring and summer. Cover crops often are planted to provide a continuous ground cover but also can be mowed or tilled into the soil at various growth stages. Once tilled in, the cover crop provides less protection against erosion.

Compost—an aerobic (oxygen-requiring) process of decaying organic matter. Fast, or "hot" composting, can be accomplished in a few weeks but requires more effort, materials, and space than slow, or "cold" composting, which can take several weeks or even months.

Mulch—material placed on the soil surface to directly or indirectly moderate soil temperatures, retain soil moisture, increase gas exchange, reduce soil crusting, reduce spread of certain diseases, reduce fertilizer leaching, reduce weed competition, reduce soil compaction, and eliminate damage from weed trimmers and lawn mowers. Most mulches are composed of plant materials, but some, such as black plastic, are man-made.

Site Selection

When planning a garden, look at all possible sites to determine factors such as light intensity, soil type and drainage, perennial weed problems, air circulation, tree root competition, and distance from a hydrant or other water source. If you have more than one location to choose from, select the best one for the type of plants you want to grow. If your soil seems totally unsuitable for gardening, consider building raised beds. In heavy clay soils, planting in raised beds results in soils that are better drained, better aerated, and more favorable for proper root growth.

Recycling lawn and garden waste can ease pressure on landfills and can return valuable nutrients and organic matter back to the soil.

Organic Matter

Adding several inches of organic matter to the soil each year helps the soil in several ways by:

- increasing drainage and aeration in clay soils;
- retaining moisture and nutrients in sandy soils, and protecting sandy soils against erosion;
- providing some of the nitrogen needed by plants; and
- increasing populations of beneficial soil organisms.

Composted animal manure or any composted plant material such as leaves, hay, or straw will do. Composted materials can be spread on, mixed into the soil, or used as a mulch around growing crops.

Avoid applying uncomposted materials to your garden. These materials are broken down by soil microorganisms, which consume nitrogen and other plant nutrients as they feed and grow. This can temporarily tie up the nutrients, making them unavailable for plant growth.

Garden Recycling

Recycling lawn and garden waste can ease pressure on landfills and can return valuable nutrients and organic matter back to the soil.

The raking and disposing of leaf litter can be reduced by creating a self-mulching landscape. Link existing trees with large islands of plants, ground covers, and mulch. The dropping leaves will then fall where they are needed to mulch these plants.

Composting

Finished compost has many uses. It can be tilled into the garden or used as a potting soil for plants if first sifted and then sterilized in the oven at 350 degrees F for 30 to 90 minutes (the compost temperature should reach 180 degrees F). Other uses include: as a side dressing for plants, as a mulch, as a soil conditioner, or as a liquid "tea" fertilizer (created by mixing the compost with water then straining).

Composting Guidelines

Composting can be a fast process, accomplished in a few weeks, or a slow process that may take several months. The following guidelines will help produce compost more quickly.

Proper ingredients—Four things are needed for composting: organic matter, microorganisms (bacteria), moisture, and oxygen.

Most organic material can be composted, but avoid using grass clippings or other debris from plants that have been freshly treated with postemergence herbicides. As a general rule, use clippings that have been collected after the third mowing following the herbicide application. Do not place meats or cooking fats in the compost pile; they can attract rodents and other scavengers and create bad odors. These products should be dried and ground into smaller pieces before being added to compost. Also, avoid noxious weed seeds, which may not be destroyed by the heat generated in the compost.

Carbon to nitrogen ratios—Materials that are brown, such as fallen leaves, provide carbon. Materials that are green, such as fresh grass clippings, provide nitrogen. (The green products will start out as a nitrogen source and change to a carbon source after several weeks, so it is important to add nitrogen sources on a regular basis.) A blend of carbon and nitrogen is best.

Compost structures—To save space, hasten decomposition, and keep the yard looking neat, build a structure for the compost pile. Base the size on the amount of yard waste generated and the speed of composting desired. A design that allows you to turn the pile and that provides covering will make the process simple and quick.

Covering the pile—Using lids or black plastic as a cover for the compost can speed up the decomposition process by trapping more heat. A covering also helps control moisture levels.

Ventilation of the bin—It is important to supply oxygen to the microbes that are decomposing the organic matter. Oxygen can be supplied by turning the pile every three to seven days. This helps assure uniform decomposition.

Adding nutrients to compost—If a soil test indicates a deficiency in your garden soil, nutrients can be added to fortify the compost pile. Examples are dried manure and organic fertilizers. The garden soil pH can be raised by adding dolomitic (or regular) lime directly to the soil. Small amounts of lime may be added to the compost pile; however, adding too much lime may cause some nitrogen to vaporize.

Shredding—Shredding landscape waste into smaller pieces quickens the composting process.

Sufficient watering—The ideal moisture content of the compost pile is best described as damp like a sponge, but not soggy. A leaf blower can help dry soggy materials.

Compost starters—Several materials can add nutrients, microorganisms, or bacteria to help start the decomposition process, including soil, finished compost, or "compost activators, which can be purchased at garden centers. Although not a requirement, adding a thin covering of the starter material over the top every time new materials are added helps keep the pile's moisture from evaporating and helps maintain a more uniform temperature.

Proper temperature—To actively kill weed seeds, pathogens, and insects, a compost pile should reach between 130 and 170 degrees F. Compost thermometers can be purchased to help determine the temperature in the center of the pile. The proper temperature also speeds the decomposition process. The temperature will be greatest after mixing or turning the pile, then the pile will gradually cool.

Materials Frequently Used in Composting

coffee grounds	hay	sawdust
corncobs and stalks	leaves	seaweed
cowpea stalks	livestock manure	straw
egg shells	newspaper	vegetable wastes
fish scraps	peanut shells	weeds
fruit waste	pecan shells	wood
grass clippings	pine needles	wood ash

Touch and smell—Finished compost will be a rich dark color, will smell sweet, will be cool, and will crumble to the touch.

Cover Crops

Cover, or green manure, crops are usually grown when the garden soil is idle but are also sometimes planted between rows of fruits or vegetables to serve as a living mulch.

Cover crops are sometimes called ~catch crops." Their deep roots absorb nutrients from the soil that could otherwise leach away or be unavailable to garden crops with shorter roots. When tilled under, cover crops decompose and release those "caught" nutrients.

You may be able to lengthen the effects of quick-release fertilizers by making smaller applications more often, instead of applying the entire recommended amount at one time.

Some cover crops, those from the legume family, even trap and transform atmospheric nitrogen in their roots. This nitrogen serves as a fertilizer source for future crops.

Cover crops in the grass or grain family don't actively fix nitrogen but usually create a thick mulch, produce a large amount of organic matter to be tilled under, and have deep roots that loosen compacted soils, thereby improving drainage and aeration.

Cover crops are divided into two categories: warm-season and cool-season, based on the optimum times to plant and grow.

Warm-season types will not tolerate freezing temperatures and should be planted after all danger of frost. Most take six to eight weeks (or longer) to grow large enough to turn under. An exception is buckwheat, which may need only four weeks under good growing conditions.

Cool-season cover crops will survive through the winter. They are planted in the fall, from mid-September until the end of October, and left over the winter to provide protection from soil erosion. They need to be planted early enough so their roots develop before winter but late enough so they do not complete their growing cycle (and die) before the weather gets cold.

A soil test ... prevents the unnecessary expense, effort, and possible contamination of the soil caused by applying fertilizers when they are not needed.

Because they are used in rotation with other crops in the same garden location, cover crops can help suppress harmful soil nematodes. Nematodes, which are parasites, tend to be hostspecific, attacking just one crop or crop family. They do not "like the taste" of other plant families, and their numbers will decline without the preferred food source.

Some cover crops, just like any other crop, may attract insects that could harm other garden crops. Gardeners should watch for pest insects in cover crops and other crops and be ready to use various Earth-Kind Gardening methods while the pest problem is in its early stages.

Legumes need certain strains of bacteria to enable them to convert nitrogen gas from the air into a form that plants can use. The bacteria needed by various kinds of legumes may or may not already be in your garden soil. To be certain, legume seeds should be coated with an inoculant powder that contains living Rhizobium spores. Commercial inoculant is usually inexpensive and widely available. Some legume seeds are sold pretreated with the proper bacteria.

Cover Crop Planting Guidelines

- Prepare the soil as you would if planting vegetables. Legumes will produce the nitrogen they need, but non-legume crops will need to have nitrogen fertilizer (1 to 1-1/2 pounds of actual nitrogen per 1000 square feet) added to the soil to produce maximum yields of organic matter.
- Inoculate legume seeds by moistening them, draining the excess water, adding the inoculant powder, and mixing well.
- Broadcast the seed evenly. Seeding rates listed in the table on pages 4 and 5 are minimum rates. Two to four times the rate may be used to assure a good stand.
- Cover seed with a thin layer of soil by raking it in or going over the area with a rototiller set **very** shallow.
- Keep the area moist until seedlings emerge. Light watering may be needed twice a day, or more, in hot weather.
- Mow and harvest cover crops before they flower and produce seeds, and till under at least 10 days to two weeks before planting garden crops.

Fertilizers

Fertilizers are used to prevent or overcome nutrient stress in plants. Fertilizers usually contain one or more of three important elements—nitrogen, phosphorus, and potassium. Fertilizers may also supply other elements essential for the growth of healthy plants.

Slow- vs. Quick-Release

Nitrogen is available in slow-release and quick-release forms.

Slow-release means that the nitrogen does not dissolve in water. The nitrogen must be broken down by soil microbes and by soil chemicals to be in a form that plants can use. Slow-release fertilizers, since they do not leach quickly, can

Some Recommended Garden Cover Crops

Cool Season

Cover Crop (legume crops are shaded)	Minimum Seeding Rate (per 100 sq. ft.)	Growth Rate	Growing Conditions	Comments
Hairy Vetch (*Vicia villosa*)	1.5 oz.	Moderate	Very winter-hardy	May be invasive; forms a dense mat. Difficult to till under if over-mature; control height by moving when crop gets more than 6 inches high.
Austrian Winter Peas (*Pisum sativum* variety arvense)	3.0 oz.		Less hardy than hairy vetch; may not be hardy enough for the Panhandle	Forms a dense mat; generally easier to till under than hairy vetch; cut back succulent vines.
Winter Rye (*Secale cereale*)	3.5 oz.	Vigorous, quick-growing	Easily established on just about any type of soil	Can be planted late in fall, but sow at least 4 weeks before first killing frost so it has time to fully cover soil; will survive winter and put on new growth in spring. Extensive root system prevents erosion and adds organic matter to soil.
Winter Wheat (*Triticum* species)	3.5 oz.		Slightly less cold-hardy than winter rye	Produces less organic matter than winter rye but still works fine; can become a weed if not tilled under well.
Crimson Clover (*Trifolium incarnatum*)	1.5 oz.	Fast	Shade tolerant; seed in warm weather to get adequate growth before winter	Sometimes grown as an ornamental for its beautiful bloom; good yield of organic matter; strong root system can open the soil.
Red Clover (*Trifolium pratense*)	2.0 oz.	Moderate	Needs well-drained soil; shade- and drought-tolerant	Upright growth habit; susceptible to root and crown diseases; in Oklahoma, is best adapted to northeastern part of the state.
White Clover (*Trifolium repens*)	2.0 oz.	Moderate	Low-growing; shade- and drought-tolerant; tolerates wet soil better than most legumes	Also called Ladino; considered taller-growing and more productive than the common "white dutch" clover that often invades lawns; good to interplant among garden crops.
Yellow-Blossom Sweet Clover (*Melilotus officinalis*)	4.0 oz.	Slow	Low shade tolerance; some drought and clay tolerance	Good to loosen compacted soils.
Arrowleaf Clover (*Trifolium vesiculosum*)	4.5 oz.		Needs well-drained soils and ample phosphorus	
Ball Clover (*Trifolium nigrescens*)	2.0 oz.		Loam to clay soils; tolerates poor drainage	Low-growing; good to interplant with vegetables; forms dense mat.
Birdsfoot Trefoil (*Lotus corniculata*)	3.5 oz.	Slow	Needs well-drained soil	Grows upright at first, but tends to lie over as it matures.
Fava Bean (*Vicia faba)*	3.5 oz.	Fast	Moist soil; hardy to about 10° F	Can be eaten fresh or dried; strong, deep root system can open the soil; excellent yield of organic matter.
Garden Pea (*Pisum sativum* varieties)	3.5 oz.		Prefers cool and moist soil; tolerates light frost.	Edible peas.
Barley (*Hordeum vulgare*)	4.5 oz.	Slower than winter rye; seed earlier in fall.	Not tolerant of sandy, acid soils.	Excellent yield of organic matter.

Ryegrass (*Lolium* species)	1.5 oz.	Quick-growing.	Cold-tolerant, but not winter-hardy.	Survives only until heavy winter freeze, but roots and wilted tops still hold and protect soil.
Purple Vetch (*Vicia benghalensis*)	8.0 oz.	Fast.	Tolerates acid soils.	Good winter-kill mulch in areas with hard frost; not as cold-hardy as hairy vetch; can be invasive and can climb trees and shrubs.
Common/White Vetch (*Vicia sativa*)	8.0 oz.	Fast.		Less cold-hardy than hairy vetch, but better fall growth.
Alfalfa (*Medicago sativa*)	2.0 oz.	Slow.	Won't grown in wet soils; tolerates drought, but not shade.	Deep root system loosens compacted soils. To grow alfalfa as a winter-kill mulch, choose a variety for garden use if seed is available, because it is easier to kill than most alfalfa. For a continuous ground cover, use non-dormant varieties, which are more cold-tolerant.
Oats (*Avena sativa*)	5.0 oz.	Fast, but less vigorous than winter rye.	Less hardy, more tolerant of wet soils than barley; tolerates only light freezes.	In much of U.S., can be counted on to winter-kill, forming a mulch that is easy to plow under in spring; good choice for plots that will get the early crops.

Warm Season

Cowpea/Southern Pea (*Vigna unguiculata*)	3.5 oz.	Slow to establish, then fast-growing.	Warm soil; moderately shade-tolerant; very heat-tolerant.	Edible beans; can underplant in corn, orchards, or vineyards.
Mung Bean (*Vigna radiata*)	3.5 oz.		Quite heat-tolerant; grows well on most soils, especially warm, sandy loam.	Somewhat easier to till under than cowpeas, but seed may be difficult to find.
Buckwheat (*Fagopyrum esculentum*)	3.0 oz.	Very fast; can be turned under after only 3- to 40 days.	Sensitive to freezing and heat; can be seeded any time during growing season up to 10 weeks before the first light frost; tolerant of poor soils.	Excellent for smothering weeds; produces lots of organic matter that breaks down easily; good green manure crop when plot is available for only a few weeks.
Hybrid Sudangrass/ Haygrazer (*Sorghum bicolor*)	1.5 oz.	Very fast and tall (6 to 8 ft.).	Tolerates heat and humidity well; needs good drainage.	Mow periodically to control height; suppresses weeds and Bermudagrass if left to grow tall.
Azuki Bean (*Vigna angularis*)	5.0 oz.		Warm soil; shade-tolerant.	Edible beans; good weed competition if sown densely.
Soybean (*Glycine max*)	3.2 oz.		Needs fertile soil, good drainage, and regular moisture; not frost-tolerant.	Garden varieties produce edible beans; stems and root systems are tough – use a tiller when working them into the soil.
Mustard (*Brassica* species)	0.5 oz.		Grows in a wide variety of soils, including pathways and other compacted ground; germinates well in cool, wet soils.	Agricultural varieties may provide more organic matter and have deeper roots, but garden varieties are milder in flavor.
Alfalfa (*Medicago sativa*)	2.0 oz.	Slow.	Won't grow in wet soils; not shade-tolerant, but highly drought-tolerant.	A perennial; can be grown year-round (see alfalfa in cool season section).

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supply nutrients to plants for a longer period than quick-release forms. The slow release rate makes fertilizer less likely to injure plant roots if used in large amounts. But slow-release fertilizers may not release nutrients fast enough to correct a deficiency causing poor plant growth.

Quick-release fertilizers easily dissolve in water. Nitrogen tends to leach and be removed from the root zone of the crop, increasing the risk of nitrate pollution of groundwater resources. You may be able to lengthen the effects of quick-release fertilizers by making smaller applications more often, instead of applying the entire recommended amount at once.

Most "organic" fertilizers are in a slow-release form. The "inorganic" or man-made fertilizers are available in both slow- and quick-release formulations.

Organic vs. Man-Made

Plants do not know the difference between organic and man-made fertilizers. The organic fertilizer materials are broken down by soil organisms into water-soluble materials identical to those in the man-made fertilizers.

Gardeners must consider several factors when choosing a fertilizer:

- cost per pound of the actual nutrients;
- rate of release;
- ease of application;
- number of applications required;
- safety to plants, especially seedlings; and
- hazards to the environment.

Application Rates

Once you have chosen a fertilizer, you must decide how much to apply.

Recommendations are usually based on the size of the garden or the area where the application is to be made. If your garden is square or rectangular, multiply the length by the width to determine the number of square feet. For odd-shaped gardens, it is often easier to visualize a rectangle that approximates the area of your garden and estimate its size.

Recommended quantities may be measured in pounds of the fertilizer per 1,000 square feet, pounds per 100 square feet, or pounds per acre.

This can cause confusion when gardeners only want to fertilize a small plot or single row. Recommendations may also call for the amount of "actual" pure nitrogen, or other nutrient, in the fertilizer. This makes calculations more confusing, because no fertilizer, whether organic or man-made, contains 100 percent of the nutrient needed.

The following formula can be used to determine application quantity:

(the recommended quantity per unit area)
÷
(percentage of the pure element in your fertilizer ÷ 100)
X
(sq. ft. of your garden)
=
quantity for your garden

Example: If the recommended quantity is 2 pounds of actual nitrogen per 1,000 feet, using a 20-10-10 fertilizer (the first number, 20, means that the fertilizer contains 20 percent nitrogen), and your garden is 500 square feet:

(2 lbs./1000 sq. ft.)
÷
(20/100) X (500 sq.ft.)
=
5 lbs. of the fertilizer for your garden

One of the problems with organic fertilizers is that they often contain only small amounts of nutrients. For example, only 7 percent of cottonseed meal is nitrogen. If a soil test recommended 2 pounds of actual nitrogen per 1,000 square feet for your garden, and you wanted to use cottonseed meal as your organic fertilizer, you would need:

(2 lbs./1000 sq. ft.)
÷
[(7/100) X 500sq.ft.]
=
14.29 lbs.

or about 14.3 lbs. of cottonseed meal for a 500-sq. ft. garden.

Depending on the type of fertilizer you choose, you could end up needing very large amounts of the fertilizer to supply the required nutrients, even truckloads, in some instances. In such a case, you may prefer to make split applications—apply only a portion of the fertilizer initially, and later apply more.

It is recommended that organic gardeners use a combination of fertilizer materials, not just one kind of fertilizer.

The chart on page 7 provides information on the amount, by weight, of nitrogen, phosphate, and potash in various organic materials. These numbers correspond to the numbers found on fertilizer tags. The last column on the chart tells the speed at which the nutrients are broken down to become available for plant use. These analyses are averages. The exact amount of nutrients in these materials may vary depending on the source, formulation, and trade name.

The labels on commercially-sold organic fertilizers, including fertilizers in the list on the previous page, often do not

specify application rates. This can be a problem in deciding how much of the fertilizer to apply to your garden. Look on the label of a similar fertilizer that does list application rates. You will need to know the rate needed of the first fertilizer and the percentage of the nutrient(s) in both fertilizers. Use the following formula to determine the application rate for the second fertilizer:

Rate of #1
X
Percentage of #1
÷
Percentage of #2
=
Rate of #2

It is recommended that organic gardeners use a combination of fertilizer materials, not just one kind of fertilizer. A variety of materials may provide a better balance of nutrients for plants.

Soil Testing

A soil test is a valuable tool to determine pH and the quantity of nutrients plants need. The test also prevents the unnecessary expense, effort, and possible contamination of the soil caused by applying fertilizers when they are not needed. Samples should be taken every two to three years. OSU soil sample bags and instructions for getting a good sample are available at local county Extension offices. The Extension educator will send the sample to the OSU soil testing laboratory. Recommendations will be made on the types and amounts of plant nutrients that need to be added to your garden soil.

Other Earth-Kind Techniques

Healthy garden soil is only one component of Earth-Kind Gardening. Other Earth-Kind techniques include cultural, mechanical, botanical, and biological pest control methods. Each of the methods are explained in OSU Extension Service fact sheets.

Other OSU publications related to healthy garden soils:

HLA-6005 Mulching Garden Soils
HLA-6007 Improving Garden Soil Fertility
HLA-6014 Making a Compost Pile
HLA-6033 Raised Bed Gardening
L-251 Recycling Yard Waste (“Don’t Bag It” series)
L-252 Leaf Composting (“Don’t Bag It” series)

Approximate Organic Fertilizer Analyses

Material	% Nitrogen	% Phosphate	% Potash	Availability
Basic Slag	–	8-11	–	slow-medium
Blood Meal	15	1.3	0.7	slow
Bone Meal	4	21	0.02	slow
Cocoa Shell Dust	1	1.5	2.7	slow
Coffee Grounds	2	0.04	0.07	slow-medium
Compost (Unfortified)	2.5	0.08	1.5	slow
Colloidal Phosphate	–	18-24	–	slow
Cottonseed Meal	7	1.3	1.2	slow
Dried Blood	12-15	3	–	medium-fast
Fish Emulsion	5	–	–	medium
Fish Meal	8	7	_	slow
Fish Scraps	7.8	13	3.8	slow
Granite Dust	–	–	5	slow
Grass Clippings	1	–	2	slow
Greensand	–	1.5	5	slow
Guano	12	–	–	medium
Hay (Mix)	1.1	0.4	1	slow
Hay (Alfalfa)	2.5	0.5	2.1	medium
Hoof Meal/Horn Dust	12.5	1.8	–	slow

Material	% Nitrogen	% Phosphate	% Potash	Availability
Kelp (Seaweed)	1.7	0.8	5	slow
Leaves	0.9	0.2	0.3	slow
Manure (Cattle)	2	1	2	medium
Manure (Horse)	0.4	0.2	0.3	medium
Manure (Pig)	0.5	0.3	0.5	medium
Manure (Poultry)	3-5	2-3	1-2	medium
Manure (Sheep)	0.6	0.3	0.2	medium
Marl	–	2	4.5	very slow
Milorganite (Dry)	5	3	2	medium
Mushroom Compost	0.5	60	1	slow
Peanut Shells	3.6	–	–	slow
Peat/Muck	2	0.5	0.8	very slow
Phosplate Rock	–	30-32	–	slow
Red Clover (Fresh)	2.1	0.5	2	slow
Sawdust	4	2	4	very slow
Soybean Meal	6.7	1.6	2.3	slow-medium
Tankage	8	20	–	medium
Wood Ashes	–	1-2	3-8	fast

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

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