

DO YOU KNOW...



Where we get our water?

- Where we store our water?
- How much water our city uses per year?
- What programs we offer?
- How much water we have saved over the years?

...where we get our water?

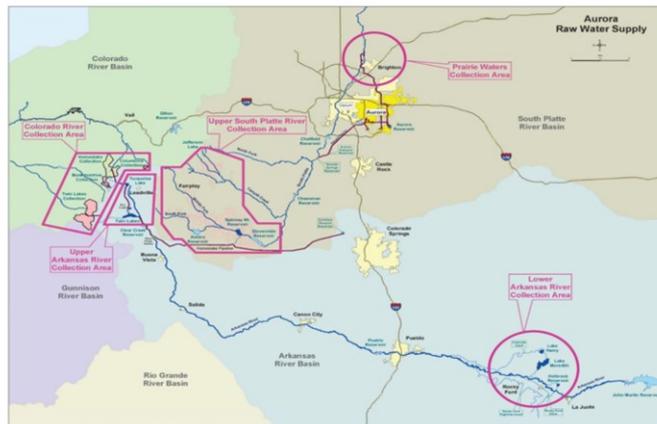


Colorado is a headwaters state, with the majority of the state's rivers beginning high in the Rocky Mountains as snowmelt. One of the benefits of living in a state that relies primarily on surface water is that unlike groundwater, surface water is a renewable water source.

One of the drawbacks is that precipitation levels vary greatly from year-to-year making the majority of the state's water supply relatively unpredictable – and highly prone to drought.

Do you know...

... where we store our water?



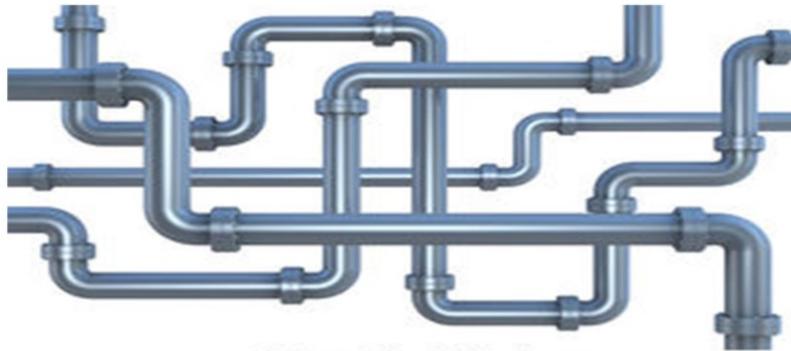
Aurora's water system starts nearly 180 miles away and includes the use of reservoirs, the natural river system, pipes, tunnels and pumps, all of which help us pull the water we own from our three river basins and deliver it to Aurora.

Aurora receives 25% of its water supply from the Colorado, 25% from the Arkansas and 50% from the South Platte river basins.

Homestake , Turquoise, Twin, Spinney Mountain, Jefferson, Strontia Springs, Rampart Quincy, Pueblo, Aurora , Meredith , Henry

Do you know how much water the city uses?

...how much water we use as a city?



16.6 billion gallons



The average annual distribution for the past three years is 16.6 billion gallons annually. About half of that water is used outdoors. Aurora has a semi-arid climate, and our snow and rain levels are about half of the average annual precipitation for the United States, so it's important that we all do our part to help conserve water.

Do you know that we offer programs to help conserve water?

...we offer programs to help you save water and money?

INDOOR

Free indoor water assessment

Ultra-high-efficiency toilet rebate

Low-income water efficiency program

OUTDOOR

Free landscape designs and rebates

Free automatic sprinkler system assessments and rebates

Customize your watering schedule

Water conservation classes

Gardening and volunteering



Do you know how much water the conservation division has saved?

...how much water the conservation division has saved?



**448 million
gallons or
7.2 billion
cups of
water**



Combined water savings for 2016, 2017, 2018

Be sure to check out our fliers at the end of class to see how Aurora Water can help you save water and money.

Grow Food, Save Water



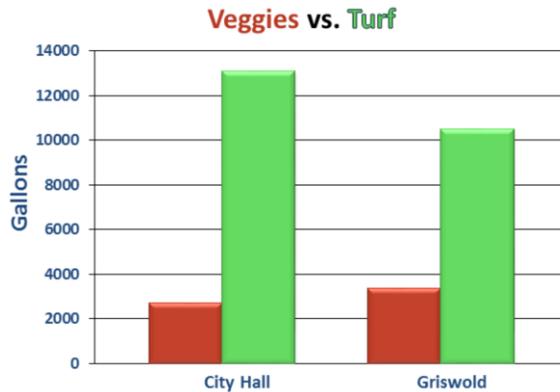


Agenda

Water use
Planning
Implementation
Composting
Tips
Discussion
Resources



Watering Comparisons



The results from converting a 600 square foot plot from turf grass to a vegetable garden were significant. At City Hall, the amount of water used for irrigation dropped from 13,000 gallons over the course of the year to 2,500 gallons. At the Griswold Water Treatment Facility, the water use dropped from 10,250 gallons to 3,500 gallons. Irrigation at both properties was reduced from 23,250 gallons to 6,000 gallons. This is an average reduction of 74%.

Figures are based on one year of findings.



Planning



Garden Sizing

Considerations:

- Household size
- Available space
- Produce preferences
- Perennials vs. annuals
- Your time & experience

Succession planting will save you space!



Household Size. It takes an average of 200 square feet to grow the amount of fruits/veggies needed by one person during the growing season at intermediate yields. That's about the size of a 1-car garage. To grow all the food for one person's needs for the whole year requires at least 4,000 square feet.

What is your **available space**? What does the space look like, how big is it, how much light does it receive?

Determine your **produce preferences**. Different vegetables have remarkable size differences. One squash plant, for instance, will take up 10 sq feet or more! One lettuce plant will take up 1 square foot.

Annuals & Perennials. Some vegetables and fruits are perennials, meaning they lay dormant through the winter or re-seed. Most are annuals, meaning you have to establish new plants every year. Some require multiple seasons to produce.

How much **time** do you have to devote to a garden? If you only have time to weed 20 square feet, don't plant a 200 square foot plot.

Experience. Are you new to gardening? Start small! Take time to learn about succession planting. You can plant only one planting of squash per season, but you can plant two plantings of lettuce: one in the early spring, one in the fall.

Succession Planting

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Onion									
		Kale					Kale				
			Lettuce				Lettuce				
			Lettuce				Lettuce				
				Cauliflower							
			Tomato								
			Summer Squash								
			Beet					Beet			
		Broccoli						Broccoli			



Succession. Remember that many plants can be planted in multiple seasons. You can have a spring / summer / winter plant rotation. This can save space.

Garden Sizing

Choice of plants makes a BIG difference

Plant	Spacing	Type
Asparagus	12"	Perennial
Beets	10"	Spring and Fall Crop
Broccoli	18"	Cool Season Crop
Beans, Pole	6"	Single Planting
Corn	15"	Succession Plant
Summer Squash	36"	Single Planting



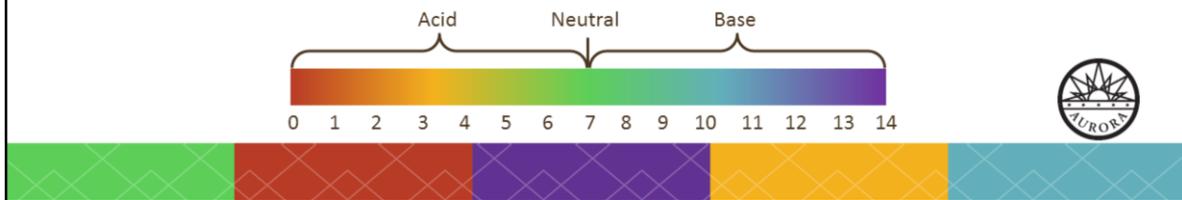
Sizing factors: spacing, planting configuration, seasonality/succession

Make sure to do research on your seeds / transplants as well as reading the back of the seed package to understand spacing requirements.

Soil

Soil pH may effect:

- (1) Nutrients
- (2) Microorganisms
- (3) Competitive ability
- (4) Physical condition
- (5) Toxins
- (6) Disease



What is soil quality and soil health? When soil is at its best it can absorb and hold moisture, support plant and animal life, and help purify the air by storing CO₂.

How to improve soil health. Any activity to the soil affects the soil quality. Conservative tilling practices, crop rotation, pest and nutrient management, and amendments help increase soil health. Leaving organic matter on the soil surface each year (at least ½ lb per 10 square feet) helps build up a rich, organic layer. The rule of thumb is 5% organic matter.

PH affects the availability of nutrients, microorganism activity, plants' competitive ability, physical condition of soil (if lime used), solubility/potency of toxic elements, and presence of disease.

Aurora has generally loam soil and clay subsoil. If you have heavily clay soil, add organic matter such as compost or grass clippings. Front Range soil is almost consistently alkaline. It is extremely difficult to increase or decrease the pH of soil. You can add acidic peat moss (although it's arguable that peat moss is an unsustainable product), pine needles or use acid-forming fertilizers such as ammonium sulfate or aluminum sulfate.

At-home pH kits have been rated and found wanting. For accurate and comprehensive results, look into CSU tests (for ph, salts, and nutrient levels, recommendations) for \$35.

www.soiltestinglab.colostate.edu

Fertilizers

N-P-K

- Nitrogen = leaf growth
- Phosphorus = flowering
- Potassium = healthy roots

Common fertilizer concentrations: 22-0-0, 10-10-10 or 5-1-1

Compost concentration is : 1-1-1



The term *fertilizer* refers to material that guarantees a minimum percentage of nutrients, almost always N, P or K. You should not purchase a fertilizer with a very high N rating (ex. 40-0-0) because it will stimulate too much growth.

Always read your fertilizer's directions and safety information before applying.

For some fantastic information on fertilizers, visit CSU extension service online and read the CMG GardenNotes #7.611, "Fertilizing the Vegetable Garden":

<https://extension.colostate.edu/topic-areas/yard-garden/fertilizing-the-vegetable-garden-7-611/>

Compost concentration numbers came from <http://ag.umass.edu/vegetable/fact-sheets/compost-use-soil-fertility>

Fertilizers

Slow release vs. Regular (quick release)

Synthetic

vs.

Natural/Organic

- Slow or quick release
- Over-application can damage
- Lasts 2-4 weeks
- Smaller amount

- Slow release
- Improves soil texture
- Lasts years
- Greater amount



Quick-release fertilizer (not typically labeled as such) **quickly release the nutrients to the plants.** This type of fertilizer is typically more water-soluble, making it dissolve faster in the soil. You should start to see growth with days of spreading a quick-release fertilizer.

Slow-release fertilizer slowly releases nutrients to plants, sometimes taking years to fully release. Many of these types of fertilizers have the added ability to improve soil texture, as well. Compost and manures for example are both slow release.

Unlike with the food we buy and eat, “organic” and “natural” fertilizers are the same thing. They are products that have been extracted from living things or from the earth. They can be either plant-derived or animal-derived. Some examples would be mushroom manure, blood meal, bone meal, cottonseed meal, kelp meal, poultry or horse manure.

Synthetic fertilizers are those composed of the synthesized chemicals of nitrogen, phosphorus and potassium.

In general, natural fertilizers contain lesser amounts of N-P-K than their synthesized counterparts, so you need to use more of them to supply your plants. However, because natural fertilizers add vital organic matter, they also improve soil texture.

Always read your fertilizer’s directions and safety information before applying.



The Design Process



Location

- Proximity to kitchen and water
- Separate irrigation zone
- Space requirements of plants
- Front yard landscape code
- Exposure
- Terrain and drainage
- Fencing



Proximity It's convenient to have the garden close to your house and/or water source

Irrigation Zones. Group fruits and veggies according to water needs and put these groupings on separate irrigation zones if needed. For example, summer squash need a lot less water than tomatoes. Many herbs, like chives and dill, need less water than most fruit-producing vegetables.

Plant spacing. Determine the size of your desired plants and each plant's light and water needs. Remember to provide supports (tomato cages) to the plants that need them: tomatoes, cucumbers, eggplant, etc.

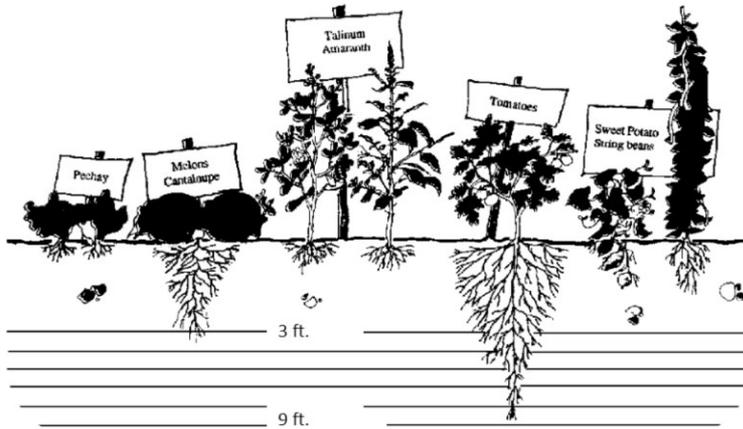
Exposure to sun and wind. Leafy veggies tolerate shade. Fruit-producing plants need full sun. Any windbreaks you build should not restrict sunlight. Living windbreaks' (like shrubs or corn) roots may interfere if they are planted too close

Code. Keep in mind the Aurora Zoning Code, which states that residents must have 50% long-lived (perennial) plant material in the front yard. So if you want a front yard garden, make sure you have at least an equal square footage of perennials.

Terrain and drainage. Ideal terrain is flat or has a slight southern slope. Veggies need good drainage and deep fertile soil. Plant with your natural contours/slopes in mind. If you have a slope, plant perpendicular to the slope and use furrows to utilize the drainage to your best advantage.

Fencing. Consider putting up fencing to keep out animals – dogs, bunnies... but be aware that some fences might block sunlight which inhibits growth of a lot of vegetables, especially warm-season veggies.

Style



We recommend planning for deep beds. If given the opportunity in very loose soil, you can see (as pictured) how far plant roots will grow down into the soil.



Rows are the traditional method and resemble large-scale agricultural practices

Blocks or wide rows create shade, reduce evaporation. This method prices 5 to 10 times more non-compacted soil space! Square-foot gardening uses blocks.

Raised beds have either sloped, natural sides or you can build up structured boxes. Build supported edges at least 10" high for a retaining structure. These require increased time, labor and money to build. However, they're good looking, good for areas adjacent to lawns or gardens with limited space, and good for gardeners with disabilities.

Container gardens allow veggies to grow almost anywhere. Make sure your containers are large enough to give roots room to grow and have enough soil to retain moisture. Plants in containers dry out more quickly and get more easily overheated. Keep them in a part-shade as weather dictates.

Going Vertical. A solution for space constraints! Some plants like lettuces, herbs, etc do well in containers or "green walls" like the one above. Think about making your vining plants, like cucumbers and some squash, grow vertically on strong supports.

Supports. Remember to provide supports (tomato cages) to the plants that need them: tomatoes, cucumbers, eggplant, etc.

Seasons

- Cool season
 - Hardy
 - Semi-hardy
- Warm season
 - Tender
 - Very Tender



Each plant has a different soil and germination temperature requirement.

There are generally three planting times:

Early (cool) season

- hardy means 2-4 weeks before last frost date
- semi-hardy means 0-2 weeks before last frost date
- e.g. lettuces, pole beans

Late (cool) season

- plant hardy and semi-hardy plants at least 6 weeks before the first frost
- great for succession planting
- e.g. lettuces, cabbage

Mid (warm) season

- tender means at last frost date
- very tender means 2 weeks after last frost date
- e.g. strawberries, tomatoes, squash

Frost free dates along the Front Range generally means May 5th-October 10th

Check out this CSU factsheet (Garden Note #720) for more information:

<http://cmg.colostate.edu/gardennotes/720.pdf>

Seeds & Transplants

Seeds

vs.

Transplants



There are really only two techniques for planting: start with seeds or start with a seedling. Seeds are inexpensive. Transplants can be pricey but are handy if it's already May and you're in a hurry. You can start your seeds indoors or outdoors depending on the plant type and time of year.

Seeds (e.g. lettuce, kale, spinach radishes):

- Some plants are only available as seed
- Read the directions on the back of the packet and pay attention to the weather.

Catalogs are a good source for heirloom and organic varieties. Heirloom means they've been passed down for generations; many gardeners consider 1951 (the year hybrids were introduced) to be the latest year a plant can have originated and still be called an heirloom. In order to be an heirloom, plants must be open-pollinated (pollination by natural means) and never genetically modified.

Saving seeds and sharing with neighbors is the cheapest. Different plants require different techniques. Tomato saving technique, for example:

1. Scoop out seeds and their gelatinous coating into a clean container. Add a couple of tablespoon of water. Cover with a piece of plastic wrap and poke a small hole in it.
2. Place the container of seeds in a warm location to ferment the mixture for 2-3 days. Each night stir the mixture and then replace the plastic-wrap. The top of the liquid will look "scummy" when the fermentation process has separated the jelly from the seeds.
3. Over a sink, carefully remove the scummy surface with a spoon and pour the seeds into a fine kitchen sieve. Rinse with water several times.
4. Line a plate with a piece of waxed paper or a large coffee filter. Place the rinsed seeds onto the wax paper or filter and spread them out so they are in a single layer. Dry up to 7 days.
5. Store fully dried seeds in paper or plastic packets.

Some plants are better started as **transplants** in Colorado, including most warm season plants like

tomatoes, peppers, and squash.

Grow your own transplants easily using a few materials and regular watering. You'll need containers, starter mix (aka seed starter), a watering tray, space, and seeds. A space with plenty of sunlight or a heat lamp is essential. Seedlings must be hardened off at least 2 weeks in advance of transplanting. **Hardening off** means acclimatizing seedlings to harsher outdoor conditions. You can start the process with an indoor fan, blowing it on your seedlings for 20 minutes, increasing to an hour a day. After they begin to strengthen, transition to placing them outdoors for 20 minutes, building to a few hours a day. The seedlings will strengthen after at least 2 weeks to and become ready for transplant.

Check out this CSU article <http://www.ext.colostate.edu/pubs/columngw/gr110416.html>.

Transplant - purchase

Seeds & Transplants



How to pick the
best transplants
Saving seeds year
to year



Nurseries and home improvement stores are convenient places to get seeds and transplants. Be careful which transplants you buy and where. Ideally you'd buy from a store with experienced staff that sources its plants nearby. These plants will have gone through much less stress than ones that travel from California. Avoid mature plants that are likely root-bound and not very adaptable. Like a dog, it's hard to teach an old plant new tricks. Purchase compact, bushy plants without blossoms or fruit. Prune off all existing blossoms or fruits before planting.

Transplant – grow your own (e.g. tomato, pepper, eggplant):

- Seedlings **MUST** be hardened off (see below) at least 2 weeks in advance of transplanting

Hardening off means acclimatizing seedlings to harsher outdoor conditions. You can start the process with an indoor fan, blowing it on your seedlings for 20 minutes, increasing to an hour a day. After they begin to strengthen, transition to placing them outdoors for 20 minutes, building to a few hours a day. The seedlings will strengthen after at least 2 weeks to and become ready for transplant.

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Irrigation

Hand water



Overhead



Drip



Stick your fingers in the soil! It's the best way to determine if your veggies need watering or if you're overwatering. Water if the top 3 inches are dry.

Consider using an irrigation system and be sure to put your garden on its own zone! Veggies don't need as much water as turf. Do not program your system to apply the same amount of water each month. Your veggies will need a lot less water in April than in July. Make sure your system does not run between the hottest and windiest hours, 10am-6pm. If you already have a system, you can realize up to 50% water savings by converting to low-pressure, adding drip lines, and using timers.

1. Hand watering works best for small areas or containers. It takes more time but is more efficient.
 - Water close to the roots
 - Use a nozzle that has an automatic-shut off valve
2. Drip/bubblers are versatile
 - For optimal efficiency, go with drip; it can be precisely targeted and there's less evaporation.
 - Space them every 12" in dense plots under mulch
3. Pop-ups / Overhead
 - Pop-ups' output level is approx 1½ inches per hour
 - Use larger drops for higher absorption rates
 - Follow city watering restrictions
 - Some diseases are associated with overhead irrigation, it can create good conditions for mildew
4. Soaker hoses are water-efficient but show some problems like clogging

Aurora Water offers a free Irrigation classes to teach you more about proper irrigation techniques.



Implementation



Tools/Materials

- Spade
- Bow rake
- Hose
- Trowel
- Gloves
- Digging fork
- Hoe
- Wheelbarrow
- Rototiller
- Journal
- Compost
- Wire cages
- Straw/grass clippings/newspaper



Generally, you get what you pay for – cheap tools are poorly designed or made of inferior materials (or both!) and will break.

Needed tools:

Spade
Bow rake
Hose
Trowel
Gloves

Additional tools:

Digging fork
Hoe

Recommended:

Wheelbarrow
Rototiller
Garden Journal

Learn how to properly maintain your new tools. Removing dirt and mud after use, sharpening and oiling them as needed, and keeping them out of rain and snow will ensure they last decades.

Step 1: Prepare the Bed



Fall Method: Fall is the best time to prepare the bed. You can add fresh yard waste because it will have time to partially decompose over the winter. Therefore, you don't have to throw out your turf, you can just turn it over and chop it up.

- You may also work manure or compost into the soil.
- For a raised bed, you'll need to add an additional several inches of topsoil. Mix well. Leave the bed until spring time. The soil will settle over the winter, returning to its normal structure and have fewer air pockets.

Spring Method: Spring also works just fine. Do not add fresh yard waste; it will not have enough time to decompose. This means you must remove turf completely, leaving as much soil that clings to the sod roots as you can. And you'll have to add composted organics into the soil. If you put down a winter "cover crop", you must use the spring method. Leftover sod: you can compost it, give it to a neighbor, or throw it away.

Step 1 is staking out the bed. All you need are stakes, twine, and a measuring tape. In the photograph above, bamboo poles were used.



Step 2: Remove Sod

Spade



Sod cutter



Non-selective herbicide



You'll need to thoroughly remove all existing plant material. If you've planned your vegetable bed for an area that's mulched with bark or rock, simply remove that mulch. Killing turf with herbicide is not recommended for organic vegetable gardening, as some herbicides are persistent in the soil and may be taken up by your vegetables.

The two main methods:

1. Spade

Make sure you're starting with a sharp spade edge for easier cutting. Work along the edge of the area you've staked out, cutting out blocks of turf one at a time, holding the spade at a low angle.

2. Sod cutter

Sod cutters make light of this hard work. You can rent one at a home improvement store. You must be especially careful around existing trees, as a sod cutter can easily damage tree roots. Cutting just one of your tree's main feeder roots can kill your tree over the next several years.

*Don't cut your energy, cable, or water lines! Call Xcel Energy, the cable company, or Aurora Water before you dig! *

Step 3: Loosen Soil

- Topsoil methods
- Subsoil methods



How you dig is just as important as what you add. Do not work wet soil! It will damage soil structure and inhibit the flow of oxygen. If it sticks to your tools, it's too wet to work.

The **Topsoil Layer** is the first 6" of soil. It has more organic matter and must be tilled every year, especially if you're adding compost or other soil amendments. Compost must be tilled in to the topsoil layer.

Tilling Methods:

1. Loosen soil with a spade
2. Rototill for the first two years to break up clay and thoroughly incorporate compost.

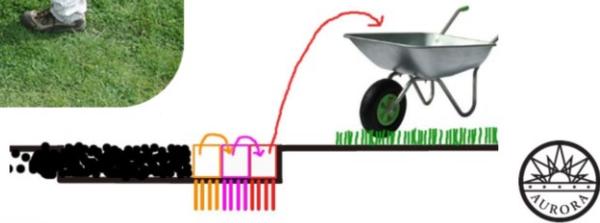
The **Subsoil Layer** is the layer from 6"-12". This layer contains minerals and micronutrients that vegetables need in small quantities that they usually can't get in the topsoil. If you loosen this layer, you help roots get easier access to these materials.

Loosening Methods:

1. Forking- a relatively quick process that eliminates the need for chopping with a spade. Fall is the best time, as it will expose clumps to the freeze and thaw cycle.
 - Loosens soil with less likelihood of disturbing soil layers or weed seeds
 - Use a digging fork or a broadfork (two handles, longer tines, tool is larger)
2. Double dig process is the best method. See the next slide.

Photos courtesy of www.finegardening.com/how-to/articles/essential-tools-working-soil.aspx

Best Practice: Double Digging



The double dig process is time consuming but thorough. It's considered a best practice among knowledgeable gardeners.

1. Dig trench as wide as spade and about one foot deep, along the entire width of the bed. This is Row 1.
2. Put all of that topsoil into a wheelbarrow
3. Loosen exposed subsoil with a garden fork
4. Start on Row 2. Place Row 2's topsoil on top of Row 1 and loosen subsoil in Row 2 with your fork.
5. Continue along, putting each new row's soil on top of the last row and loosening the newly exposed subsoil.
6. Put the soil from Row 1 that is in the wheelbarrow on the last row.
7. Soil amendment may be incorporated in the process.

Unless your soil is very poor, you'll only need to go through this process once every several years.



Step 4: Amend Soil

- Organic amendments
- Fertilizer
- Soil tests



Amending is vital. Organic amendments “build” the soil that feeds your plants. Clay and sandy soils will both benefit from organic amendment, as it improves texture, creates appropriate pore space, increases water-holding capacity, and adds nutrients. Incorporate amendment thoroughly and deeply; it is helpful to apply during soil tilling. All amendments are depleted over time, so replenish at least biannually in your vegetable garden.

Compost is decomposed organic material. Add 2-3 inches across your entire garden. Choose fully decomposed material free of insecticides, herbicides and weed seeds. If you have only partially decomposed plant material, add in the fall so it has time to decompose fully; garden debris and fresh grass trimmings are only recommended for fall applications.

Manure is fresh animal waste. It has the potential to “burn” roots and may be contaminated by bacteria (including e. coli), so only add it in the fall so it has time to decompose fully. Look for aged/composted manure which does not smell and is dark in color. Manure may be high in salts, so add only 1 inch per season.

Cover crops aka green manure are plants planted in the fall and allowed to die naturally in the winter. They decompose with tilling in the early spring, adding nutrients and aerating the soil. It virtually eliminates your need to haul in and add amendment! Mow and then till in the material a month before planting.

Peat moss is low in nutrients and is not recommended. Plus, peat moss is a non-renewable resource and harvesting practices are questionable: peat moss bogs are fragile ecosystems and harvesting is disruptive.

Fertilizer. There are many different types of fertilizer, with different effects on soil and plant material. Fertilizer is like artificial life support and we advocate soil building over fertilizing. Soil building does takes time. Consider using fertilizer as a once-a-year supplement for leafy crops which require more nitrogen.

Natural types of fertilizer: compost tea, guano, worm castings, bone meal, fish emulsion

To remember when applying fertilizer:

- Applications near seedlings can burn roots
- Too much fertilizer can limit fruiting

Soil Tests. Determine the chemical composition of your soil. See slide #10 for details.

Step 5: Planting Technique

Sow



vs.

Plant



There are really only two techniques for planting: start with seeds or start with a seedling. Seeds are inexpensive. Transplants can be pricey but are handy if it's already May and you're in a hurry. You can start your seeds indoors or outdoors depending on the plant type and time of year.

Direct sow (e.g. lettuce, kale, spinach radishes):

- Sow outdoors when soil conditions meet requirements of that particular seed's germination.
- Start with a smooth garden bed surface
- Create furrows with hoe or wood edge
- Drill into soil with a finger to a depth related to seed size (see instructions on seed packet)
- Cover and gently pat soil to establish seed-soil contact
- "Water in" your plant so that the soil is moist but not drowned

Transplants

- Remove the container completely. Even "compostable containers" must be removed
- Dig a hole twice as wide and just as deep as the root ball/container
- Press the soil around the root ball with your hands so that there are no air pockets
- "Water in" your plant so that the soil is moist but not drowned

Label your rows with popsicle sticks, stakes, or similar.

Step 6: Mulch



- Benefits
- Precautions
- Types
- Application



Mulch is a surface covering applied to the garden bed. It's benefits include:

- Retains moisture
- Prevents erosion
- Keeps plants clean
- Provides a place to walk
- Creates a tidy look
- Prevents crusting
- Prevents weeds
- Prevents compaction

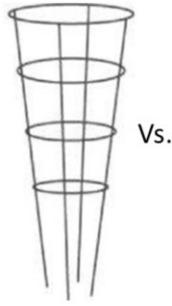
Careful! Mulch may slow soil warming in the spring. It may also keep the soil more moist than you planned on, so adjust your irrigation accordingly. Make sure to mulch thickly, about 3", to discourage weeds.

Organic vs. Inorganic

Plastics are not recommended. They warm soil, are expensive, need to be disposed of, add nothing positive to the soil, and prevent water and oxygen from flowing between soil layers.

Straw, grass clippings, and newspaper all decompose relatively quickly and add nutrients to your soil. Apply 3 inches of material when plants are about 6 inches tall.

Step 7: Support



Vs.



Many of your vegetables will need additional support. Veggies that become heavily laded with large fruit will need cages. These vegetables include tomatoes, eggplant, tomatillos, etc. Veggies that vine will need climbing support. These vegetables include peas, beans, squash, etc.

We find that tomato cages (picture on far left) do not provide enough horizontal support for tomatoes, and instead recommend that wire fencing material be wired into a cylinder shape.



Maintenance



Watering



- Amount
- Critical stages
- Variables
- Plant choice
- Schedule



Watering amounts affect produce quality and yields. Vegetable gardens on the Front Range generally require between 1 and 1.5 inches per week, but pay attention to the weather and adjust accordingly!

Critical Stages. Veggies do not go dormant like bluegrass, they produce best with steady and uninterrupted growth. Maintain even levels of moisture. That said, water is most critical at the following stages: (1) seed germination, (2) 1st few weeks of development, (3) after transplant, (4) flower and fruit production.

Variables

These techniques and conditions require less water: mulch, closer spacing, clay soils, healthy soil with lots of organic matter.

These techniques and conditions require more water: raised beds, containers, and sandy soil

Other variables: Sun, heat, wind and soil type

Plant Choice High yield/small fruiting varieties need more water

- Beans and corn use more water.
- Tomatoes, peppers, vine, summer squash need less water. They're often overwatered.

Watering Schedule

- Before seedlings emerge: Hand water, maintain consistent moisture!
- After emergence: Back off to get good root establishment

Important Tips:

ALWAYS physically check soil moisture, get your fingers in the dirt!

Temporary wilting is okay with some plants during the hottest part of day

Clay soil? Water less frequently but for longer periods

Sandy soil? Water more frequently for shorter periods

Pest Management

Weeds & Critters



Weeds compete for water, nutrients and light, and harbor pests. Use all of the following techniques:

- Pull them when they're young. Use a hoe or shovel to pull out the entire root.
- Mulch 3" deep to make it harder for weeds to grow.
- Spray glyphosate (RoundUp) on perennials, but not in or near an organic garden.
- Corn gluten is a nontoxic, pre-emergent weed inhibitor. It prevents weeds from germinating.

Insects. Depending on the species, use multiple methods:

- Hand pick pests and remove them from the garden or drop them in a solution of 1 T. liquid dishwashing detergent and 4 c. of water, which will cause them to drown.
- Natural pesticides: garlic spray, hot pepper wax, insecticidal soap, NEEM oil

Japanese beetles are small, shiny bugs that feed on most plants. They can devour most of the foliage on favored plants like roses, beans, grapes, and raspberries. Look for leaves that are "skeletonized" (only have veins remaining). Hand picking is the most effective way to get ride of Japanese beetles.

Aphids are tiny, soft-bodied insects that vary in color from green to red to dark gray. They feed on many vegetable types and in large swarms can cause leaf curling and retard plant growth. Try insecticidal soaps or NEEM oil, or use high water pressure to wash them away aphids and remove their sticky honeydew. They will not be able to climb back up the plant. Purchasing ladybugs (an aphid's natural predator) is not recommended.

Grubs are beetle larvae. They will eat your vegetable roots, and some grow into beetles that will eat the leaves. As you're tilling and planting in the spring and summer, be on the lookout for these white, curled larvae that are up to 2" in length. Either remove them to another part of your yard or kill them.

Critters love veggies. To keep out mammals, create a physical barrier like a chicken wire fence, burying it at least 6" deep into the soil. Dig up grubs and either kill them with your trowel or move them to

another part of your garden where they'll do less damage. Hot pepper spray will also keep rabbits from chomping on the same plant twice.

Pest Management

Diseases



A dark canker at the **bottom** of tomatoes is the classic symptom of **blossom-end rot**. This relatively common garden problem is not a disease, but rather a disorder caused by a calcium imbalance, usually due to uneven watering. It can occur in pepper, squash, cucumber, and melon fruits, as well.

Powdery mildew is a fungal disease that affects a wide range of plants. It thrives in warm, dry climates, and easily spreads in areas of high humidity. It typically shows up on the leaves of vining plants, but can effect many different vegetables. It is non-toxic, but it will retard the growth of your vegetables.

To control powdery mildew, remove all the infected plant parts and destroy them as soon as you notice powdery spots on your plants. You may also use fungicides, including sulfur, lime-sulfur, neem oil, and potassium bicarbonate. If you don't want to use fungicides, try spraying your plants with a bicarbonate solution. Mix 1 teaspoon baking soda in 1 quart of water and spray plants thoroughly.

Avoid watering plants from overhead, which can raise relative humidity, and prune overcrowded areas to increase air circulation

Mosaic virus infects more than 150 types of plants including tomatoes, squashes, cauliflower, and cucumbers. It is characterized by leaves mottled with yellow, white, and light and dark green spots or streaks. Plants are often stunted or have crinkled or wavy leaves. Unfortunately, once a plant is infected, there are no controls. Remove all the infected plants and destroy them.

Do NOT compost any infected plant, as the disease can persist in the compost.

Pest Management

An ounce of prevention is worth a pound of cure.

Rotate crops

Choose disease-resistant varieties

Harvest on time

Avoid monocultures



Use **integrated pest management** which uses multiple methods at once or in the same season. Use the least invasive or toxic method to protect your produce and use deterrents that work with nature. Make educated decisions. Like with most things, prevention is the key! If your plans are healthy, they can ward off disease/pests.

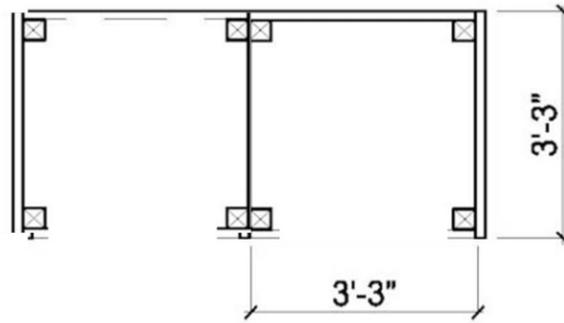
- Avoid monocultures that provide feasts and havens for pests
- Harvest on time to reduce likelihood of rotting plants that attract insects
- Rotate crops to reduce likelihood of diseases establishing in soil
- Choose disease-resistant varieties



Composting



Your Bin



We recommend a two-bin system for beginners, with each bin 3'x3'x3'.



The bottom left photo shows a two-bin system made from wooden pallets.

What to Compost

“Greens”

- Fruits and vegetables
- Coffee grounds and filters
- Tea bags, tags/staples removed
- Wet yard trimmings
- Grass clippings

“Browns”

- Eggshells
- Nut shells
- Shredded paper or newspaper (nothing shiny)
- Dry yard trimmings
- Straw
- Leaves
- Sawdust
- Hair and fur
- Wood ashes

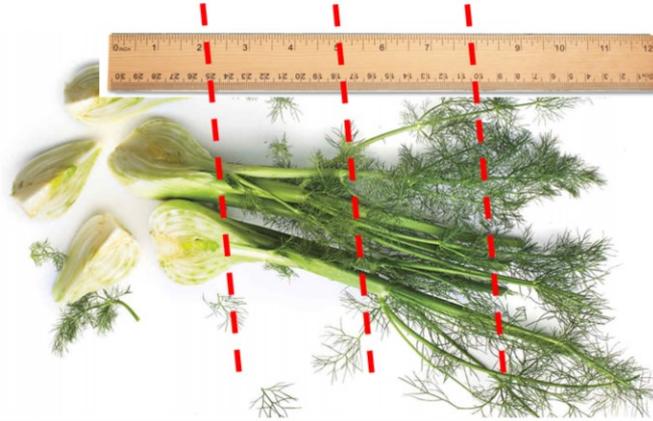


What Not to Compost

- Dairy products
- Diseased plant material
- Fat, oil, grease
- Meat or bones
- Feces, cat litter
- Charcoal ashes
- Wood chips or sticks
- Anything plastic like fruit stickers, tea bag tags, wrappers



Cut to Size



Contain Your Enthusiasm



If you want to store your kitchen scraps instead of taking them out to your bin every day, feel free to use whatever kind of container you want. We recommend that you choose one air-tight with a tight-fitting lid. Store it in your refrigerator to slow down the decomposition process, keep away bugs, and eliminate smells.

Layers I



Carpet covering

Native soil

Browns

Greens



Layers II



Carpet covering

Dusting

1/3

2/3



Layers II



One other important ingredient: water! You want your pile to be consistently moist, at about the moisture level as a wrung-out sponge.

Compost Tips

1. Distribute large masses of the same type of item
2. Two chambers are better than one
3. Start small
4. Compost bins need what we need!
 - Shelter
 - Water
 - Exercise
 - Diverse Diet
 - Chewed Food



1. Because grass is a green material and tends to form a mat after being cut and piled, simply tossing grass clippings into your compost pile can result in a slow and/or smelly compost pile. Make sure that you mix or turn the grass clippings into the pile. This will help distribute the green material evenly through the pile and will prevent the grass from forming a mat in the pile.

2. Whether you choose to use an open bin or a compost container, two chambers are always better than one. In fact, if you are really serious about composting, having two chambers is a necessity. Because the composting process takes at least several weeks under the best conditions, you cannot add additional materials to the heap without “resetting the clock” to day one. To create an ideal batch of fully composted material, your mix needs to “cook” for at least several weeks; if you add additional material, you’ll have a mix of fully decomposed material, partially decomposed material, and fresh materials. It’s simply much easier, and much more desirable to use a consistent mixture of fully decomposed compost for gardening purposes. After all, you wouldn’t want to buy a bag of potting soil that contained a rotting tomato in it!

3. Small bins are easier to turn. So it’s best, if you’re a beginner, to start with smallish chambers, about 9 square feet each.

4. Compost bins need what we need!

- Shelter: two-bin system, 3'x3'x3'
- Water: moisture like a wrung-out sponge
- Exercise: turn it twice per month
- Diverse Diet: balanced carbon and nitrogen
- Chewed Food: 2-3" pieces



Veggie Recommendations and Tips



Most cost-effective veggies

1. Tomatoes
2. Lettuces
3. Bell peppers
4. Winter squash
5. Broccoli
6. Cauliflower
7. Garlic



Hot Summer?



Plants have natural systems that respond to heat problems. Transpiration is a mechanism plants use to cool themselves by pumping water out through the leaves for a kind of swamp-cooler effect. But high heat can cause a plant to exhaust water supplies in this process; or the plant closes its stomata to prevent water loss and in so doing reduces ability to take in CO₂, needed in the photosynthesis process.

Some solutions:

1. Select plants that have a tolerance for high heat: peppers, certain species of tomatoes, chard, eggplant, some melons. Do some research.
2. Build your soil. Provide nutrition and organic matter that will retain moisture and allow rain to penetrate to lower depths. Stay away from products that add salt to the soil, like fresh manure and some fertilizers.
3. Keep soil cooler with mulches that break down quickly in the soil – newspapers, straw, grass clippings (that have not been chemically treated)
4. Consider moving your garden to an area that gets partial shade. This is especially important for your container gardens.
5. Build a shading structure to protect your plants, especially on the western side to protect them from afternoon sun. Use shade cloth or light fabric row covers that are high enough to allow good air movement.

Colorado Gardener Education Issue 2013



Resources



More Classes

- Colorado State University Cooperative Extension
ext.colostate.edu
- Denver Urban Gardens
dug.org
- Garden Centers
- Aurora Water Conservation
aurorawater.org



The Colorado Master Gardener Program offered through CSU Cooperative Extension has Fruit Trees, Fruit, and Vegetable Classes among many others. Check out <http://cmg.colostate.edu/>

Other public classes are available through CSU. Contact information at www.ext.colostate.edu

Denver Urban Gardens offers in-person classes. Visit www.dug.org for more information.

Aurora Water Conservation offers many classes online and in the classroom. Check out Xeriscape: Start to Finish, Meal Prep, Water Diversion, Irrigation 101, to name a few. See all our offerings here:
www.aurora.gov/AuroraGov/Departments/AuroraWater/WaterConservation/OutdoorWater/042654?ssSourceNodeId=658&ssSourceSiteId=621

Other Resources

Colorado Gardener
coloradogardener.com

The Gardener's Bible
by Edward Smith

**Edible Front Range
Magazine**
ediblefronrange.com

Square Foot Gardening
by Mel Bartholomew

Grow Local Colorado
growlocalcolorado.org

***Organic Gardener's
Companion***
by Jane Schellenberge

Carrots Love Tomatoes
by Louise Riotter



Colorado State University Cooperative Extension is a gold mine of information on gardening in Colorado. They have hundreds of fact sheets on everything from identifying pest problems to planting trees to growing the perfect tomato.

Denver Urban Gardens (DUG) assists with the development and management of over 80 community gardens in the metro area. "Primarily serving low to moderate income populations in urban neighborhoods, DUG provides opportunities for participants to supplement their diet with produce grown in nearby public gardens."

Edible Front Range Magazine is a quarterly magazine that celebrates the abundance of local, seasonal food in along Colorado's Front Range.

Grow Local Colorado is a project by community leaders, gardeners, locavores, farmers and businesses to help more people grow more food locally. Its website is a resource hub for information, expertise and partnerships for establishing a garden at your home, business, or public space.

Carrots Love Tomatoes by Louise Riotte is a great book on companion planting.

Thank You

Water Conservation Office

Hotline 303-739-7195

conservation@auroragov.org



Contact Diana Denwood if you have:

1. Questions
2. Interest in volunteering at the city's xeriscape and vegetable garden
3. Interest in starting or participating in a community garden