LESSON 6
Irrigation

San Diego County is in a semi-arid region, meaning that there is very limited naturally-occurring fresh water. We typically get approximately 10 inches of rain annually (compared to San Francisco's more than 20 inches of annual rainfall). Most of our piped water for irrigation, household and business uses comes from the Colorado River and from the Northern California delta system, by way of aqueducts that move water south. Both of these water sources are ultimately limited, and extraction and transport of the water creates numerous environmental challenges, so it's vital that we as Southern Californians don't take our water for granted. Active water conservation in our daily lives is required to maintain our water supplies over the long term.

As gardeners, we have a particular responsibility and opportunity to conserve water whenever possible. The aim in irrigation should be to provide enough water to make our gardens grow but do so with as little wasted water as possible. That means learning the water needs of each type of plant you grow by regularly and carefully observing your plants, soil, and the weather and designing an efficient irrigation system to respond to water needs. Hand-watering is a good option. It helps provide water when and where it's needed, and gives you an opportunity to observation your garden on a regular basis.

Also it's important to know that the quality of water in San Diego is both alkaline (around pH 8) and saline. The more water used the more salts that are added to the soil.

As a general rule, once a plant is established, watering less often but deeper is recommended, for these reasons.

1. Watering deeply encourages roots to grow deep and produces a robust root system. The opposite is also true; shallow watering produces shallower, weaker roots.
2. Roots breathe and need both air and water. Overwatering or watering too often drives air out of the root zone and plants can literally drown.
3. San Diego water is very salty and infrequent, deep watering helps flush salts down out of the root zone. Frequent, shallow watering allows more evaporation which leaves salts behind.

Learning Objectives

1. Understand the water needs of various types of edible plants.
2. Know the different options for irrigating a garden.
3. Know the basics of rainwater and greywater harvesting.

Materials Needed

- **Several sealable plastic bags with mixed irrigation parts for identifying (connectors, tubes, tape, emitters, etc); paper for irrigation plans**

Water Needs

For information on needs of particular plants see "Water Conservation in the Vegetable Garden" at: www.ext.colostate.edu/mg/gardennotes/716.html.

1. Regardless of the watering system used, the goal should always be to water a little more (about 10% more) than the rate in which plants and evaporation remove water from the soil. The purpose in using extra water is to cause water to drain through the root system/container in order to carry away excess salts (that are dissolved in our water) so they do not accumulate to a harmful concentration. Considerations to keep in mind:
   a. Sandy soil will lose water more quickly than clay soil. It takes one inch of water to penetrate one foot of sandy soil. It takes two inches of water to penetrate one foot in clay soil.
   b. Hot and windy weather dries out soil.
   c. Larger plants consume more water than seedlings; however, seedlings need to stay evenly damp at the surface, while established plants need deeper water.
   d. Daily or every other day observation will allow you to respond to a plant's water needs quickly.

2. Developing plants, large enough to be transplanted, should be watered deeply but less frequently to encourage deep root growth. Once developed, some crops such as corn, tomatoes, asparagus have deep roots that require less frequent watering.

3. Crops such as lettuce, chard, beets, and green beans have shallower roots (less than 1' deep), and require thorough soaking of the root zone more frequently. Water again when the plants show wilting during the hottest part of the day.

4. Observing the soil and plants will inform you about water needs. Watch for drooping plants. You can stick your finger into the soil fully. If it feels cool and moist, there is probably adequate water. You can also test the soil by digging down 6-8 inches, taking a handful and squeezing. You might also use the article, "Estimating Soil Moisture by Feel and Appearance", noted in References at this lesson's end to determine available moisture. Soil tests mentioned in Lesson 3 may also be used. You can also purchase a small, inexpensive soil moisture meter, which you insert in the ground to check soil moisture levels.

ACTIVITY 1
Try doing a soil-moisture feel test with the soil on site, using the resources, techniques and tools mentioned above.

Irrigation System Types

1. *Handwatering* minimizes wasted water since you water each plant directly and can adjust watering times and duration for each plant. You also maintain close contact with your plants in the process of watering and can respond to problems early. It can make good sense in a small garden but is time consuming.

2. *Drip irrigation or soaker hoses* provide water slowly and directly to the soil and roots of the plant, for high water use efficiency. Any irrigation system using tubes and hoses requires periodic flushing to remove sediment buildup and blockages; to flush the system remove all stoppers at the ends of lines and let the water run until the flow is regular.
   a. A soaker hose is like a regular hose (flexible) with perforations to let water out slowly at various points.
   b. T-tape is similar to a soaker hose in that it emits drops of water out of holes regularly spaced along the tape, but it must be positioned in a straight line. It is efficient for plants that are spaced closely together in rows.
   c. Polytube uses drip emitters at each plant; it is efficient for watering larger, more widely spaced plants like tomatoes. It can be positioned in circles and curves allowing for a wide variety of garden design.
   d. Ollas (pronounced "oyas") are unglazed clay pots with a narrow opening that are buried in the ground, with their opening slightly above ground, and filled with water. Nearby roots grow toward the porous pot for water. This ancient irrigation method reduces evaporation and provides water directly to the roots.

3. *Sprinklers* typically the least efficient method of delivering water to a plant (much water is lost to evaporation), but they are simple to set up and can be moved easily. Many plants are harmed by water on their leaves, which can spread fungal plant diseases. For these reasons sprinklers are not a recommended option for vegetable gardens. *(Note: Both sprinklers and drip systems can be set up as automated systems with timers to turn on automatically, but it is important to still observe the garden regularly to make sure you are not under- or over-watering.)*

ACTIVITY 2
Hands-on discovery of the various types of irrigation components (hoses, emitters, connectors, etc) and how they work together.

ACTIVITY 3
Design a system for the class garden space, using soil, plant, and access considerations. Compare with classmates.

Rainwater Harvesting-Active and Passive

Passive rainwater harvesting means designing the landscape to catch and retain water.
You can design your landscape to catch water naturally and healthy soil can store a lot of water. Building low berms and swales can catch and redirect rainfall from driveways, sidewalks and other hardscapes in addition to roofs. More rainwater is available in passive systems than in active where the source is only the rain that falls onto roofs. Using sunken, highly absorbent soil garden beds reduces the soil's exposure to evaporation and directs rainfall into these slight depressions. It is possible to capture all the rain that falls on your property resulting in zero runoff to the street!

Active harvesting is setting up storage barrels or cisterns for captured rainwater off roofs. An active system can be as simple as leaving containers, such as trashcans, out in the rain. To catch more rain, install roof gutters that drain to a container.

One inch of rain on a square foot of level surface sheds 0.623 gallons of water. To determine your roof-harvesting capacity, multiply the square footage of your house (divided by two if two stories) by 6.2, which is the expected gallons per square footfor a typical San Diego year of 10 inches of rainfall. You will need:

- A storage tank that will hold the number calculated, or less if you plan on using the water consistently;
- Gutters to catch the rainfall;
- Piping to move the rain from gutters to tank;
- Piping to move water from tank to garden.

Greywater Harvesting

Greywater is water that is harvested after it's been used in the home. In February 2010, a new state plumbing code was adopted in California that exempts some greywater use from the permitting process. Greywater is defined by the State of California as "all bathroom sink, shower, bath, and laundry water". Kitchen, dishwasher, and toilet water are considered to be "black" water. The new California plumbing code has important guidelines that need to be followed when reusing greywater. Here are a few of them:

a. Greywater needs to be distributed under 2 inches of mulch, preferably into a mulch basin, or covered by a "greywater outlet shield;"

b. Greywater needs to be dispersed at least 2 feet from buildings and 1.5 feet from property lines, never to neighboring properties or streets, and at least 100 feet from bodies of water;
c. Excess water during the winter months, toxic substances like chlorine and boron, and soiled diapers must be diverted to the sewer or septic system.

For more detailed information about the new code, see
www.oasisdesign.net/greywater/law/california/currentcode.

One of the more popular greywater systems is the Laundry to Landscape Irrigation System. This is permit exempt and can be used in most homes to water portions of the garden. It is hooked up to a washing machine and run into the garden, and is most effective with fruit trees, perennials, and vegetables. A diverter valve near the washing machine controls flow to either the landscape or septic/sewer system. Multiple zones can also be set up in the garden to increase the coverage. Older washing machines using 40-50 gallons of water per load offer this kind of expanded use. It is recommended that liquid soaps low in salts, sodium and boron or laundry washing balls and plant-based cleaners be used for plant health and the environment. Learn more about greywater at www.ecolandscaping.org/10/water-recycling/greywater-harvesting-an-abundant-resource

References

1. CA Dept of Pesticide Regulation.
"Estimating Soil Moisture by Feel and Appearance."
Available at: www.cdpr.ca.gov/docs/county/training/inspprcd/handouts/soil_moist_feel_test.pdf
A detailed, photo-filled resource on hand tests of soil moisture.

2. Colorado Master Gardeners.
"Water Conservation in the Vegetable Garden."
Available at: www.ext.colostate.edu/mg/gardennotes/716.html
Water needs of particular vegetables and tips for conserving water.

3. Ecological Landscaping Association.
"Greywater: harvesting an abundant resource."
Available at: www.ecolandscaping.org/10/water-recycling/greywater-harvesting-an-abundant-resource
A news article on greywater harvesting - trends and how it's done.

4. Oasis Design.
"California greywater standard."
Available at: www.oasisdesign.net/greywater/law/california/currentcode
Links to current California code on greywater harvesting.

5. Lancaster, Brad.
"Rainwater Harvesting for Drylands and Beyond."
Available at: www.harvestingrainwater.com

6. Greenamyer, Bob.
"Irrigation Parts - a Simple Guide."