

# Soda Bottle Hydroponics - Growing Plants Without Soil

*A lesson from the New Jersey Agricultural Society  
Learning Through Gardening program*

**OVERVIEW:** In this lesson, students will explore how to grow plants without soil and why people would want to grow plants this way. Students will see exactly how hydroponics works by making a hydroponics system with a soda bottle.

**OBJECTIVES:** The students will be able to:

- Explain what hydroponics is.
- Describe different types of hydroponics.
- Describe the advantages of hydroponics.
- Explain how their own hydroponics soda bottle works.

**GRADES:** PreK-5

*(Teachers may want to demonstrate the construction of the soda bottle hydroponics system for younger children.)*



## **MATERIALS:**

New Jersey Agricultural Society power point presentation *Hydroponics - Growing Plants Without Soil*, available to download from the Learning Through Gardening Teacher Tool Box: <http://www.njagsociety.org/teaching-science-in-the-garden.html>.

1-liter or 2-liter clear soda bottles for each group of three or four students

Cotton towel or old T-shirt cut into strips that are 1 inch wide and 10 inches long, one for each group *(You can also use cotton string.)*

Jumbo cotton balls, 10-15 for each group

Lettuce seeds

MiracleGrow powder fertilizer

Epsom salts

Eggshell

Lemon or lemon juice

*Hydroponics - Growing Plants Without Soil, Facts for Kids* sheet for each student

## **PREPARATION:**

You must cut the tops off the soda bottles about 4 inches down from the top or at the "shoulders" of the bottle. To do this, use a knife to slit an opening and then use scissors to cut all the way around the bottle. Teachers of older students may want to just make the slit with a knife on all the bottles and then let the students finish the cutting. Teachers of younger students should cut the bottles themselves.

## PROCEDURE:

Show the *Hydroponics - Growing Plants Without Soil* power point or read the *Hydroponics – Growing Plants Without Soil, Facts for Kids* sheet. Discuss with students and answer any questions.

Explain that you are going to make your own classroom hydroponics system using soda bottles.

### *Making the Soda Bottle Hydroponics System:*

- Cut the top off the soda bottle about four inches from the top. (*See Preparation notes above.*)
- Turn the top over and insert it into the bottom of the bottle like a funnel.
- Tape the edges of the top and bottom of the bottle together with waterproof tape. (Duck/duct tape works well.)
- Fill the bottle halfway with water.
- Thread a strip of cotton towel or T-shirt through the hole to the bottom of the bottle, so that the bottom of the strip is submerged in water and the top end drapes over the funnel.
- Shred the cotton balls by pulling them apart. Hold the end of the cotton strip up and layer the shredded cotton balls around the inside the top of the bottle. The end of the cotton strip should lay on top of the cotton balls.
- Use a watering can or spray bottle to soak the cotton and the top of the cotton strip with water. Spread lettuce seeds lightly all over the cotton.

Set the soda bottles in a sunny spot. Now observe the growth of the plants. Students can record daily in their science journals what they observe. It should take 10-14 days for the lettuce to grow little leaves.

The seeds do not need nutrients to germinate, as all the nutrition a plant needs to sprout is stored in the seed. When the leaves appear, photosynthesis will begin and it is time to add nutrients to the water.

*To make the nutrient solution you will need a 2-liter bottle with a cap. (You can use a 1-liter bottle – just cut the recipe in half.)*

- Fill the bottle with water.
- Add 1/4 teaspoon of Miracle Grow or other plant food.
- Add 1/8 teaspoon of plain Epsom salts.
- Add 5 drops of egg shell extract (see recipe below)

Shake well.



# Hydroponics – Growing Plants Without Soil

## Facts for Kids

**Hydroponics** is a way to grow plants without soil. In hydroponics, the nutrients or important materials plants need to grow, are put into water and then taken up to the plant through its roots.

Outside, in nature, a plant's roots do two things: they take up water and nutrients from the soil, and they help fix the plant to the ground so it isn't blown away by wind. Mineral nutrients needed by plants are often naturally present in the soil, but farmers also add them with fertilizers.

Indoors, farmers do not need to worry about the wind, so the roots only job is to deliver nutrients to the plant. This can be done by putting nutrients and the plant's roots into water.

There are several different ways to build a hydroponics system. Sometimes, the plants are hung in nets or other structures with their roots dangling into the water below. In some systems, the plant's roots grow in materials other than soil. This material supports them and leaves lots of space around them.

One example of these support materials is vermiculite, which is a mineral that looks like a stone but is very light and can absorb water easily. The outer husks of coconuts are also used, as well as a material called rock wool, a light substance that is made by blowing air through very hot rocks.

**Aeroponics** is another form of hydroponics. In aeroponics systems, the roots do not sit in water. The plants hang in the air, and water containing nutrients is sprayed on the roots. A larger variety of plants can be grown with aeroponics, as some plants do not like to have their roots sitting continuously in water. NASA is interested in aeroponics to grow plants in space because managing a spray is easier than handling liquids in zero gravity.

**Aquaponics** is another type of hydroponics. In this system, the roots of plants float in a fish tank. The fish help the plants by providing all the nutrients they need in the form of fish poop. Bacteria in the water break down the fish poop into nutrients that the plant roots can absorb. The plants help the fish by removing the fish poop from the water and keeping the water clean. If the water becomes too dirty, the fish will die.



## **There are many advantages to growing plants hydroponically:**

No soil is used.

Plants are off the ground and inside, so there are no weeds and fewer insect pests and diseases.

Hydroponic gardens actually use less water, even though the plant always sits in water. Less water is needed than for crops in the ground, and the plants are never over-watered or under-watered. Water in hydroponics systems is always recirculating.

Hydroponics is a perfect way to grow plants for areas without good soil, such as deserts or very cold climates. All the stations in Antarctica have hydroponics systems to provide fresh vegetable for the scientists who work there.