



# Hydroponics Made Easy!

Time needed: 30-45 minutes  
Key Concepts:  
Hydroponics, Plant Biology

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## Introduction:

**Do you think plants can grow without soil? If you've tried growing veggies, you probably planted the seeds or seedlings in soil. Soil gives the plants the nutrients they need to grow. However, plants can grow without soil, too, using a process called *hydroponics*. In this activity, you will transform a 2-liter soda bottle into a mini-garden that needs only light, air, and nutrient-rich water to grow!**

## Supplies Needed:

- 2-liter plastic soda bottle, emptied and cleaned
- Permanent marker
- Scissors or utility knife
- Thick cotton or felt strips (2), about 2 by 20 cm. Strips of an old towel work well.
- Growing medium, like coconut coir or hydroponics clay pebbles, both available at well-stocked garden stores or on Amazon
- Seeds or a small plant. Start with a green leafy plant like spinach or lettuce, or herbs like oregano or basil.
  - *Note:* If you are starting with seeds and use clay pebbles, you will need to purchase rapid rooter plugs; available at well-stocked garden stores or on Amazon.
- Purified, filtered, or bottled water. Avoid unfiltered tap water, as that can contain contaminants that may inhibit your plants' growth.
- Plant nutrients for green leafy plants like GH Flora Grow; available at well-stocked garden stores or on Amazon
- Disposable gloves
- Measuring spoon
- Large container or second bottle with lid to prepare the water
- Area that receives plenty of light to store the container
- Optional: pH control kit like this [General Hydroponics PH Control Kit](#); available at well-stocked garden stores or on Amazon
- Optional: Aluminum foil

## Prep Work

1. Although some growing mediums used in hydroponics (like coconut coir) look like soil, they are not the same as soil. Soil and coconut coir are both growing mediums, but soil contains nutrients a plant needs to grow, and coconut coir does not.



**Weigh the dry medium in your hands. Do you notice how light it is compared to soil?**

2. If you are using coconut coir as your growing medium, prepare it by adding water to the coconut coir brick, as directed on the package. This loosens it so it can expand.



## Procedure

1. In this project, you will try hydroponics—the process of growing plants without soil. In hydroponics, the plant grows in a medium that retains moisture but does not contain nutrients. Instead, the nutrients are mixed into the water.
2. We will start by creating a hydroponics container from the empty, clean 2-liter soda bottle. Use the permanent marker to draw a line around the bottle just below where the cylinder starts to curve in toward the cap.
3. Cut the bottle along the line with your scissors or utility knife. Adult supervision is recommended for this step.



4. Flip the top upside down and rest it in the larger bottom part of the bottle. You will grow your plant in the upside-down top part, and the bottom part of the bottle serves as a reservoir to hold the water.



5. A wick will transfer nutrient rich water from the reservoir to the roots of the plant. To create the wick, knot the two cotton or felt strips together at one end.



6. Push the loose ends through the bottle top so they hang down into the reservoir. The knot should stop the wick from going all the way through; if it does not, retie a larger knot



7. Place the top with the wick back into the reservoir. Fill the growing area with the growing medium. A growing medium in hydroponics is inert, meaning it does not contain nutrients, like soil does. Be sure to pull the wick up about 2/3 of the way into the growing medium. This will ensure that the water and nutrients stored in the reservoir reach the plant's roots



**In hydroponics, plants grow on nutrient-rich water. Why would we still use a growing medium?**



8. You will use chemicals in this project. Handle chemicals with care, including wearing gloves. Adult supervision is recommended.

9. Measure 1 quart of bottled, filtered, or purified water into your second bottle or container. Avoid unfiltered tap water, as that can contain contaminants that may inhibit your plants' growth.

10. Plants need nutrients to thrive, and these nutrients are not found in pure water. You need to add them. Look on the label of the liquid nutrients bottle to find out how much of the solution you need to add to a quart of water in the growing phase of the plant. Mix that into the water in your second bottle or container. Your tiny plant will not consume much, so the water you prepare now will last until the plant is somewhat larger.



**Why do you think larger plants need more nutrients?**

11. Optional: Pure water is neutral (pH of 7); it is not acidic, like lemon juice, or basic, like ammonia. Plants absorb nutrients best if the water is slightly acidic. Too acidic (pH well below 7) or too basic (pH higher than 7) are not ideal. If you have a pH control kit, follow the instructions that come with the kit to test the acidity of the quart of prepared water. Adjust the acidity of the water by adding a few drops of acid (if the pH is too high) or base (if the pH is too low), as directed by the kit.

12. If you are starting from seeds and using coconut coir, place three seeds in the coconut coir just above the knot in the wick. If you are starting from seeds and using pebbles, seeds cannot germinate when placed in clay pebbles; you will need a rooter plug or soil plug for them to germinate. Place three seeds into the plug and place the plug just above the knot in the wick. Cover the seeds with the growing medium (seeds germinate better when in the dark).

13. If you are starting with a small plant, plant it directly into the growing medium. Make sure the roots get close to the knot in the wick and be careful not to damage them.

14. Pour the prepared water over the growing medium. It will seep into the reservoir. Keep pouring until the reservoir is about 1/2 to 2/3 full. The water should never reach the spout of the bottle. Make sure that the area around the seeds or tiny plant gets wet as you pour the water.



15. Optional: the reservoir can stay exposed to sunlight, but algae will grow and turn the water green. This will not hurt the plant, but it will not look very pretty! To prevent this, you can cover the reservoir with aluminum foil.



16. Seeds can germinate in the dark, but once they emerge above the soil, plants need air and sunlight to survive. Once the seed is sprouted, place the container near a window and wait.



**Why do you think plants need light to grow?**

17. For the first couple of days, check daily to make sure the area around the seed or tiny plant is moist. Add a little water if needed. As the plant grows, its roots will extend deeper and get better access to the water and nutrients sucked up by the wick.



**Why do you think you need to keep the area around the seedling or tiny plant moist when it is small, but no longer need to once the plant is larger and established?**

18. Once the plant is established, check the water level in the reservoir weekly. Make a new batch of nutrient-enriched water when you start to run low, and add it when the water level gets low. Check the directions that come with the nutrients; you will probably need to add more nutrients for the same amount of water once the plant is well-established.



## What Happened?

Did your plant thrive? That is expected!

Just as we get our nutrients from food, generally plants get their nutrients from the soil. Plants also need water. Water helps to transport nutrients from the soil throughout the plant. It is also needed for photosynthesis, the process by which plants turn light into sugars. The plant uses these sugars as food. Photosynthesis also requires carbon dioxide, a gas that is present in air. In short, plants require nutrients, water, light and air.

In this project, you tried hydroponics—the process of growing plants in nutrient-rich water. In hydroponics, the plant grows in a medium that retains moisture but does not contain nutrients. Instead, the nutrients are mixed into the water. A plant with its roots in soil expends a lot of energy extracting its nutrition from the soil. In hydroponics, the nutrients are directly available at the plant's roots. So, without any work, the plant gets its water and nutrition. Because of this, it can spend more energy growing leaves, fruits, and flowers so it generally grows more in a shorter amount of time.

## Digging Deeper

Plants need water for several reasons. First, water acts as a solvent and helps to transport nutrients from the soil throughout the plant. Second, water-filled cells help support various biochemical reactions in the plant. A biochemical reaction is a reaction that occurs between chemicals inside the plant's cells to keep it alive. A plant biochemical reaction that you may have heard of is photosynthesis.

Photosynthesis is a reaction involving sunlight, the chlorophyll in plant cells, water, and carbon dioxide. It produces sugar for the plant to use as food. When a plant doesn't receive water, photosynthesis and other biochemical reactions stop, the plant begins to turn yellow, dries up, and then dies.

Plants also need nutrients. They need both macronutrients (like carbon, nitrogen, and phosphorus) and micronutrients (like iron, sodium, and zinc). Soil can contain all of these, but plants can absorb these nutrients even faster from nutrient-rich water, and that is what hydroponics is all about.

The word hydroponics means "working water" and comes from the Greek words *hydro*, meaning "water," and *ponos*, meaning "work." In hydroponics, the nutrients are available at the plant's roots. So, without any work, the plant gets its food and nutrition.

There are six basic types of hydroponic systems: wick system, water culture system, ebb-and-flow system, drip system, nutrient-film technique, and the aeroponics system. Each system has its advantages and disadvantages. In this plant biology activity, you experimented with the wick system.

## For Further Exploration

- Compare how fast plants in nutrient-rich soil grow versus hydroponics plants. If you grow herbs or vegetables, compare their taste as well.
- Study the role of nutrients in plant growth by growing plants on nutrient-rich and nutrient-poor water. To do so, plant seeds in identical hydroponics containers, as explained in this activity. Give half of the plants nutrient-enriched water and the other half pure water. Do you think the plants getting nutrient-rich water will grow faster, grow bigger leaves, or just look healthier?
- Study how the acidity of the water influences plant growth. To do so, plant seeds in identical hydroponics containers, as explained in this activity. Give all the plants nutrient-rich water. Make the water in the reservoir acidic (pH = 5 or lower) for a third of the plants, basic (pH = 9 or higher) for another third, and neutral (pH = 7) for the last third. Do you think the acidity of the water will influence the growth of the plants? What do you expect to see?
- Can you give plants too many nutrients? Test it out and see!