

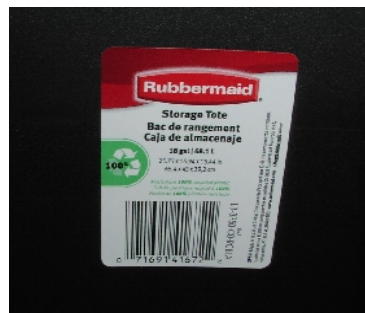
## HOW TO BUILD A SMALL EBB & FLOW SYSTEM



This is a great, dependable little unit. You can grow four- 6" to 8" pots or several smaller plants. It costs about \$90 in early 2009 (not including a lamp and food). Most of the materials are available from Home Depot or Walmart. A few items must come from a hydroponics supplier (but we give you a good cheap source).

### **SUPPLY LIST:**

- ◆ Rubbermaid Black Storage Tote Bin with lid- 18 gallon [Walmart]  
(Or similar sturdy tote bin of 16-20 gallon volume)
- ◆ Rubbermaid Snaptoppers Clear Tote- 30 qt. [Lowe's or Home Depot]  
(Or similar flat bin that will fit on top of the tote bin)
- ◆ Timer, mechanical garden; 15 minute increments [Walmart]
- ◆ Aquarium air pump, 6 feet of airline tubing, "T" connector & 5 inch airstone [Walmart]
- ◆ 4 cheap flower pots, 8" [Home Depot or Walmart]
- ◆ Small bag of perlite [Home Depot or garden center]
- ◆ Black irrigation tubing, ½ " I.D. (inner diameter) about 18" long, [Home Depot]
- ◆ Small submersible pond pump- 120 gph [heres one cheap: <http://www.hydroponics-simplified.com/cheap-hydroponics-supplies.html#ebb>]
- ◆ Fill and drain fitting set with one extension [order below]
- ◆ One brick of coco coir & small bag of LECA (Hydroton or clay balls) More on this and ordering info later in the Tips 'N Techniques section.





### **TOOLS NEEDED:**

- ◆ Power drill; 1-1/4" hole saw & 3/8" regular or spade drill bit  
(Borrow a hole saw kit or buy one, you will definitely use it again).



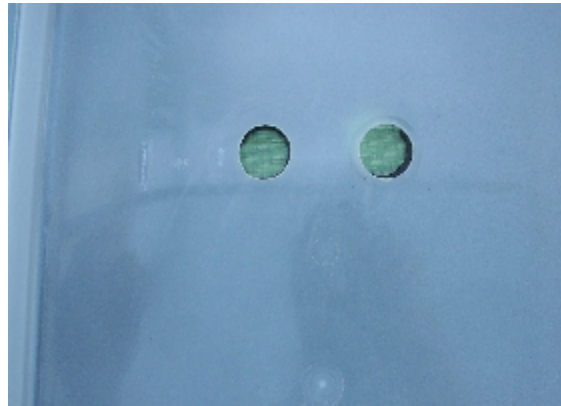
This is what the ebb & flow drain fittings look like. They are the major plumbing for this system. The shorter pipe allows the fluid to flow up into the planting bed. The taller one acts as an overflow valve. When the level of fluid reaches the slits, it starts to drain back down into the reservoir, preventing the table from overflowing its sides. The overflow tube in this photo has 2 extension pieces on it. We only use one extension for this project, so it won't be this tall. You can order the complete kit here for a few bucks: <http://www.hydroponics-simplified.com/cheap-hydroponics-supplies.html#ebb>

### **Here's how to build the system:**

1. Cut two 1-1/4" holes in the center of the clear Snaptopper tray. Smooth the rough edges lightly with a file or sandpaper. Your 4 pots need to fit around these 2 holes, see below.



**2.** Place clear tray on top of the black tote lid, and center it carefully both ways. Mark the exact center of each hole in the tray onto the black lid with a marker. Then cut two 1-1/4" holes in the black lid where marked. The idea is to line the holes up in each piece as shown below.



- 3.** Cut 2 additional 1-1/4" holes in either side of the black lid:  
-One is for the pump plug and bubbler tubing to pass through  
-The other is to check the fluid level and to add nutrient solution after assembled.



- 4.** Screw the two drain fittings into the center holes in the clear bin only. The rubber gasket goes on the **underside** of the bin. Hand tighten securely, but do not use tools or you will strip them out. Place **ONLY ONE** extension on the overflow tube (the thicker, 3/4" tube), as shown below.



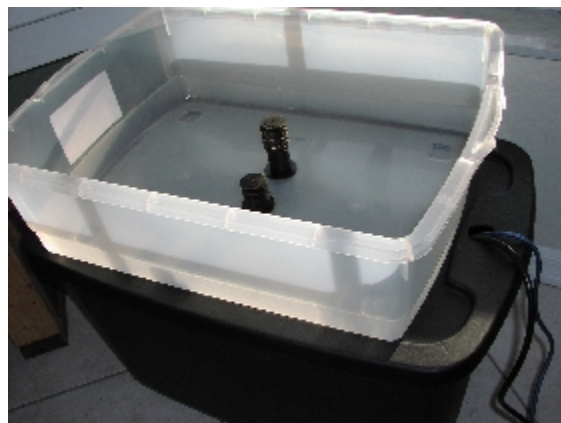
- 5.** Place 1/2" irrigation tubing over the water pump outlet fitting. Depending on the type of tubing or hose you have, you may have to secure the tubing onto the pump outlet with a zip tie, or may have to taper the inside of the tube with a razor knife if it is too small. You want a nice snug fit.



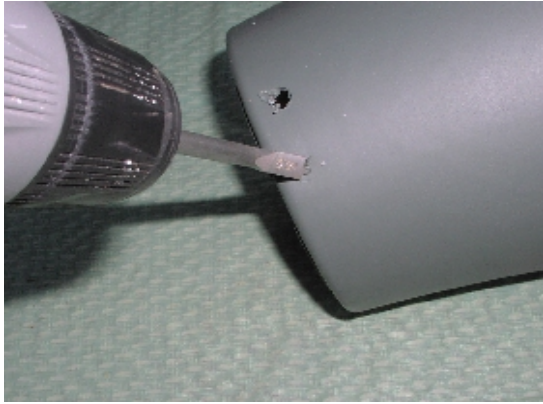
6. Place the clear tray with drain fittings in place over the black lid, lining up the holes. They should line up nicely and snap down onto the black lid.



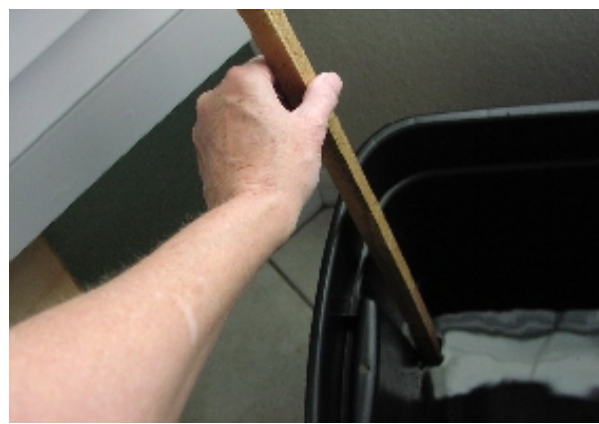
7. Trim the 1/2" black tubing to a length that allows the pump to sit on the bottom of the black tote bin (reservoir) when the lid is on. This may take some dry runs and measuring to get it right. Then push the tubing over the port of the SHORTER drain tube (the 1/2" or inflow tube) from the underside of the black lid. Use a zip tie if necessary to get a snug fit. You don't want this tubing slipping off either end during assembly. Drop the bubbler stone into the bottom of the black bin, and run the airline tubing and the pump plug through the side access port you drilled into the side of the lid (see below, left). Then place the lid/tray assembly on top of the tote, and snap into place.



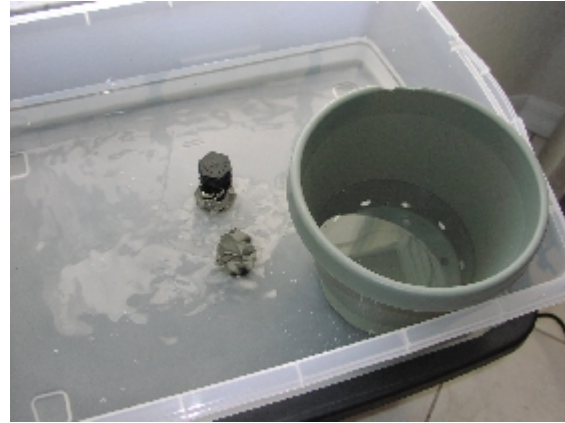
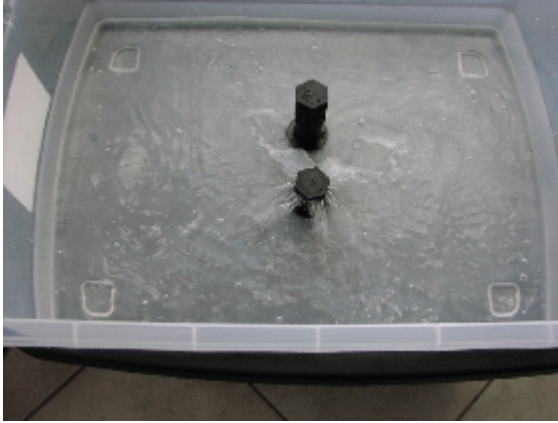
8. Now for the plant pots. I used 8" green flower pots from Home Depot, for a couple bucks each. They didn't quite fit in the bin, so I trimmed some of the lips on the tops of the pots with a razor knife so they fit in nicely. I wanted the largest pots I could possibly squeeze in there. You could also use several smaller pots if you wanted to grow herbs or the like. Drill several 1/4" or 3/8" holes around the **sides** of the bottoms of the pots, to provide good fill and drain of nutrient solution, as shown below.



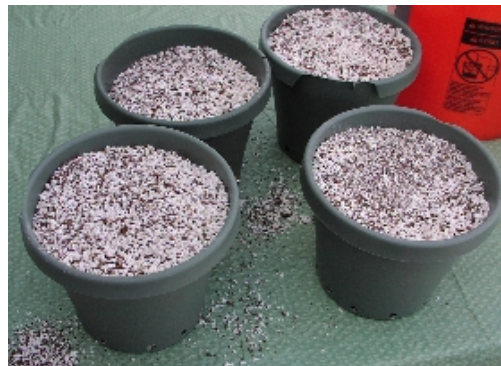
9. Make a "dipstick" out of 1x1 stick or a wood dowel. Take the time as you add each 2 gallons of water to the reservoir bin to dip the stick in and mark the dowel with permanent marker at each level. This will help you gauge the nutrient level later without removing the top and plants.



**10.** Fill the black bin (reservoir) with **10 gallons** of water. Add a nutrient concentrate of choice. If you are using GH Flora Series (recommended), add 10 tsp. each of the Flora Grow, Flora Micro & Flora Bloom, (one at a time, in that order). [Order it in quart bottles below]. Adjust the pH of the solution with a test kit (more on this later, too). Plug in the bubbler and pump and test the system for operation and leaks. **Note:** the setup must be on a level surface.



**11.** Fill the pots with your favorite hydroponics medium. We recommend a 50-50 mixture of coco coir and perlite, with an inch or two of LECA (Hydroton or clay balls) at the bottom. The coco/perlite mixture provides great moisture holding and aeration. The hydroton at the bottom keeps the medium from flushing away out the drain holes. It makes a great sub-layer wick for ebb & flow pots. (More details and ordering of media in the Tips 'N Techniques section at the end).



**12.** Now plant your seedling plants into the pots and pack the medium firmly around the plant. You cannot start seeds right in ebb & flow pots, as the moisture will not reach the top to keep the seeds moist. Start them first in grow cubes or pellets, or buy store-bought seedlings and rinse away all the dirt from the roots before transplanting to the pots.



**13.** It's a good idea to "top water" the plants for the first few days to make sure they don't dry out while they get used to their new ebb & flow home.





**14.** If you find that a small amount of water remains in the bottom of the tray (like 1/4") after the drain cycle ends, you will need to raise the pots up off the bottom so they won't sit in the standing water (and rot). Place something about 1/2" thick underneath them to get them up just a little but not too high. Whatever you use, it must be inert and not add chemicals to the nutrient solution (don't use bricks). Use something made out of plastic. We used some thin plastic slats left over from some old shutters.

**15.** Plug the water pump into the timer and set to fill 3 times a day, **for only 15 minutes** each fill cycle. (6am, noon and 6pm is good). Let them rest through the night; no feeding.

**16.** The bubbler with airstone stays on 24/7. This oxygenates and aerates the nutrient solution, keeping it from becoming stagnant.

Earlier we listed the cheapest supplies we could find, to help keep the cost of this setup low. However, you might want to go to a pet shop and buy an upgrade air pump for the stone. We bought this one for \$20 and it is super quiet! Also look for a circular airstone. **Important tip:** the air pump must be placed higher than the reservoir to prevent backflow of solution into the pump.



This air pump has two outlet ports. If yours does too, then buy the "T" adapter and tie in both ports to one airstone. No use wasting half those precious bubbles!



**Now continue on for the very important Operating Tips 'N Techniques:**

## **EBB & FLOW SYSTEM OPERATING TIPS 'N TECHNIQUES**

### **LIGHTING:**

You can use just the light from a sunny window if all you are growing are houseplants. Anything else requires some supplemental lighting. A T5 compact fluorescent "grow light" will do fine for houseplants, herbs, and leafy green veggies like lettuce. This one is available for under \$75, including the 125 watt compact T5 bulb:



You can order this lamp and bulb here: <http://www.hydroponics-simplified.com/cheap-hydroponics-supplies.html#lighting>. You can get off much cheaper by getting a fluorescent "grow stick" at Walmart for about \$25, but you will not get the lush growth a better light setup will produce. For best results, upgrade to the 200 watt bulb listed on our supplies page.

If you are interested in fruiting veggies like tomatoes, or serious herbs, you will have to upgrade to an HID lamp. Learn more about HID lighting and see our special combo lamp deal here: <http://www.hydroponics-simplified.com/hydroponic-lights.html>. One final note: the grow room must be kept cool. Use a fan on low in there to cool it down. HID lamps will really add some heat.

### **NUTRIENTS:**

We highly recommend the **Flora Series** nutrient solutions put out by GH (General Hydroponics). This stuff is superior, easy to use, and reasonably priced. It consists of 3 parts (Flora Grow; Flora Micro; and Flora Bloom). If you have hard water, get the Hardwater Flora Micro instead. For this smaller garden, order a quart of each of the three solutions: <http://www.hydroponics-simplified.com/cheap-hydroponics-supplies.html#nutrients>. Stick with Flora Series, follow the label directions, and you can't go wrong!

The nutrient reservoir must be kept cool (55-70°). This is especially important for the cool-season crops like lettuce and broccoli. Learn more about hydroponics nutrient solutions here: <http://www.hydroponics-simplified.com/hydroponic-solution.html>. We also provide a nifty little mixing chart there for the Flora nutrients that you can print out and save.

As the nutrient level drops in the reservoir bin, you need to periodically add water only (not more nutrient). Keep track of how many gallons you top up with. When you have replaced 5 gallons of water, stop topping up and let the level drop down towards the pump. When it starts "sucking air", drain the bin and mix up a whole new batch of nutrient solution. Each new 10 gallon batch should last 3-5 weeks by following this "50% system".

**pH-** It is a very good idea for any serious hydroponics project to keep the pH of the water in the proper range, which is 5.5 to 6.5 (6.0 is ideal). If the pH is out of range, some of the nutrients get "locked out" and the plants suffer. GH puts out a simple test kit with pH up & down solutions **cheap**. It will last you through *many* gardens: <http://www.hydroponics-simplified.com/cheap-hydroponics-supplies.html#nutrients>.



## **GROWING MEDIA:**

You can actually use whatever growing medium you prefer in the ebb and flow pots. We recommend a 50/50 Coco Coir and perlite mixture for the growing area. Line the bottom of the pots first with 2" of LECA (Hydroton; clay balls). LECA provides an excellent wick for the nutrient solution and prevents all the Coco/perlite mixture from washing away during the ebb cycle.

This is a brick of Coco-Coir and a handful of Hydroton clay balls:



Here is a cheap source for your media: <http://www.hydroponics-simplified.com/cheap-hydroponics-supplies.html#media>.

Perlite can be bought at any garden center. Coco Tek and Hydroton balls must be ordered from a hydroponics supplier. Learn more about hydroponic growing media here: <http://www.hydroponics-simplified.com/hydroponic-growing-medium.html>.



We hope you will try out our plans for this cool little ebb and flow hydroponics system. You will be amazed at the scope and amount of produce you can reap from this unit. It provides a great introduction to hydroponics for adults and children alike, and it's just plain FUN.

Our guess is that once you get a taste of hydro in this way, you will go on to bigger and better things. This field of horticulture is wide open! There are many different methods for you to try, and you'll just get more knowledgeable and skilled at it as time goes on.

You might try growing heirloom tomatoes, medical herbs or even orchids. Or you might just enjoy munching on your own healthy, homegrown salad micro-greens! No matter which way your interests take you, you are sure to enjoy this clean, healthy, prolific, earth-friendly gardening method. We just love hydroponics and know you will too.

Visit our website: <http://www.hydroponics-simplified.com> often for updates on equipment, lighting, nutrition, plants and seeds, pests, grow-closets, and plans for several other different growing systems. We provide simple information, insider secrets, and easy-to-follow instructions to get you up and growing in no time...



*Enjoy!*  
*Simon & Stella*

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