

# Modular BioSand Filter

Water Purification Using Sand and Common Hardware

Copyright © Constantine Orfan, 2014

[constantine@h2ohow.com](mailto:constantine@h2ohow.com)

In October (2010), I have built a modular biosand filter made from 2-gallon white plastic paint buckets. The buckets are made of food-grade (number 2) polyethylene plastic and are the same buckets you can find at most hardware stores worldwide. Figure 1 shows a photograph and Figure 2 shows a drawing of the prototype filter. I believe this modular water filter meets the critical design requirements of the [biosand filters](#) developed by the [CAWST](#). The basic difference is the modular design breaks up the normal single column biosand filter into three or more stacked 2-gallon sections or modules. The top 2-gallon module forms the biological zone where pathogens are removed by the biolayer (or schmutzedecke). The subsequent middle and bottom modules form the non-biological zone(s) where mechanical trapping and adsorption play a major role in removing any remaining contaminants, pathogens and parasites.

In this design, the 2-gallon modules are stacked one on top and inside the other forming a stable filter column. The siphon tubing is used to assist the first water connection between the top 2-gallon filter - that includes the biolayer - and the middle 2-gallon filter. The siphon tubing is wrapped in a way that allows water to flow down the stack while maintaining enough standing water to nourish the biolayer. The middle filter has a small drainage hole at its base to complete the water flow to the bottom filter that includes the outlet tube. Finally, a larger 5-gallon bucket may be used to store treated water. The 5-gallon bucket may be used as the container that kits all the parts and tools used to assemble the modular filter.

## Assembly Instructions

**Please be aware, this is a pre-filter tool. Treat filtered water with sunlight, heat or chlorine before final storage and consumption - as I describe elsewhere on my website.**

Below, I have included detailed assembly instructions. First, familiarize yourself with the general principles of a [biosand filter](#) - I will only touch upon the sticky parts of my modular variant - Please refer to my [drawing](#), below.

In my modular design, you are using four buckets in a stack. The most top bucket is for feeding water (slowly) to the other three. The (top) BioSand Filter bucket uses siphon pressure and gravity to deliver the water to the middle Sand Filter bucket. From the middle, gravity (alone) moves the water to the bottom Sand Filter. Gravity pressure from the stack forces water to flow from the bottom Sand Filter bucket tube or faucet.

1.) Care needs to be taken to make the BioSand Filter bucket - first. Prepare a 1/2-inch diameter hole for the tubing to come out the side. Make it 1-inch down from the top of the bucket. Begin with one length of tubing (about 32-inches) that runs from the INSIDE bottom and out the hole. Use waterproof foil tape to seal the area where the tube comes out. A proper gasket or food safe putty are other way to form a seal. Do the best you can. Add your clean sand, pebbles and rocks as shown. Add water to the bucket and test the siphon. A proper siphon maintains about a 2-inch of standing water at all times. Check for leaks and seal as needed.

2.) Prepare the other two Sand Filter buckets. Make a small drainage hole at the bottom of the middle Sand Filter bucket. Add sand, pebbles, rocks and tubing as shown. Stack the two Sand Filter buckets together.

3.) Stack the BioSand Filter bucket on top of the two Sand Filter buckets. Wrap the remaining OUTSIDE tubing section down and along the bucket. You insert the end into the narrow gap between the two buckets. Cut off any extra tubing.

It does takes some practice.

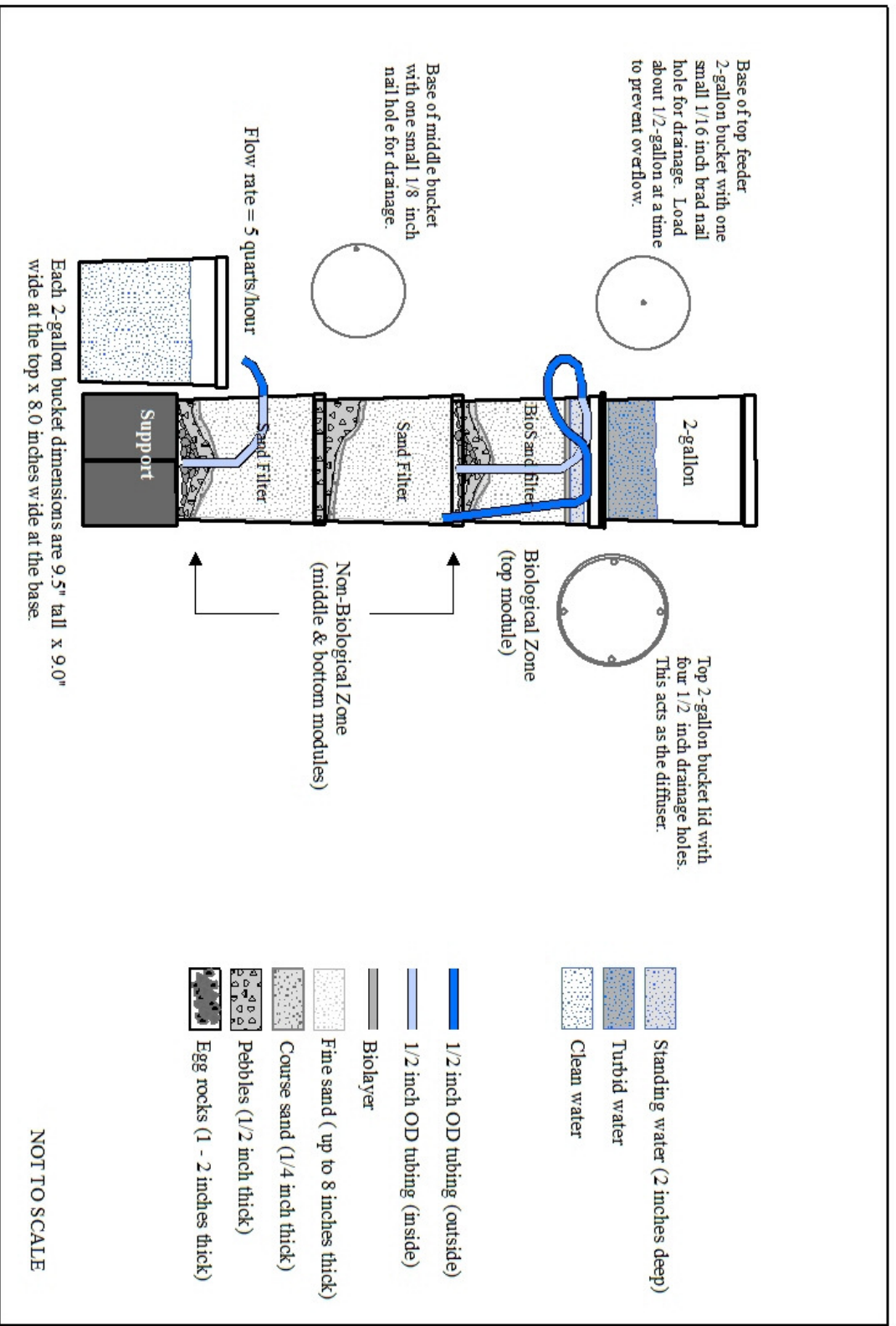
## **Advantages**

The main advantages of the modular biosand water filter design include:

1. Low cost - less than \$20 for everything (including tools, sand, pebbles, etc).
2. Available - uses ordinary components that may be obtained worldwide.
3. Lightweight - plastic body weights a few pounds. Filled with sand, each 2-gallon module weights ~23-lbs. The complete filter with three modules filled with sand and gravel weights less than 75-lbs - compared to over 200-lbs for an empty concrete biosand filter.
4. Portable - all parts and tools fit inside a 5-gallon bucket (kit) that a child can carry and transport.
5. Durable - heavy duty plastic won't corrode, crack or break under normal use.
6. Easy to assemble - one able-bodied person + 30 minutes.
7. Easy to maintain - no breakable or moving parts to wear out. Needs periodic simple cleaning. Modular design assists trouble-shooting.
8. Sustainable - simple technology and made mostly of sand.
9. Modular design - 2-gallon biosand filters may be prepared prior to adding other sand filters in the stack. Water filter stacks may be customized according to local water conditions - adding or deleting 2-gallon sand filters. In some cases, activated carbon modules and other filter materials may be added to improve removal of heavy metals and known chemical contaminants.



Figure 1. Modular BioSand Water Filter (prototype).



Modular biosand water filter using 2-gallon plastic paint bucket connected by 1/2 inch vinyl tubing. Note, the siphon tubing is wrapped in a way that allows water to flow down the stack while maintaining enough standing water and air to nourish the biolayer and biological zone. Updated 12-05-11. Source: Constantine Orfan - H2oHow.com, constantine@h2ohow.com

## References

Center for Affordable Water and Sanitation Technology  
<http://www.cawst.org/>

Biosand Filter  
<http://www.cawst.org/en/resources/biosand-filter>