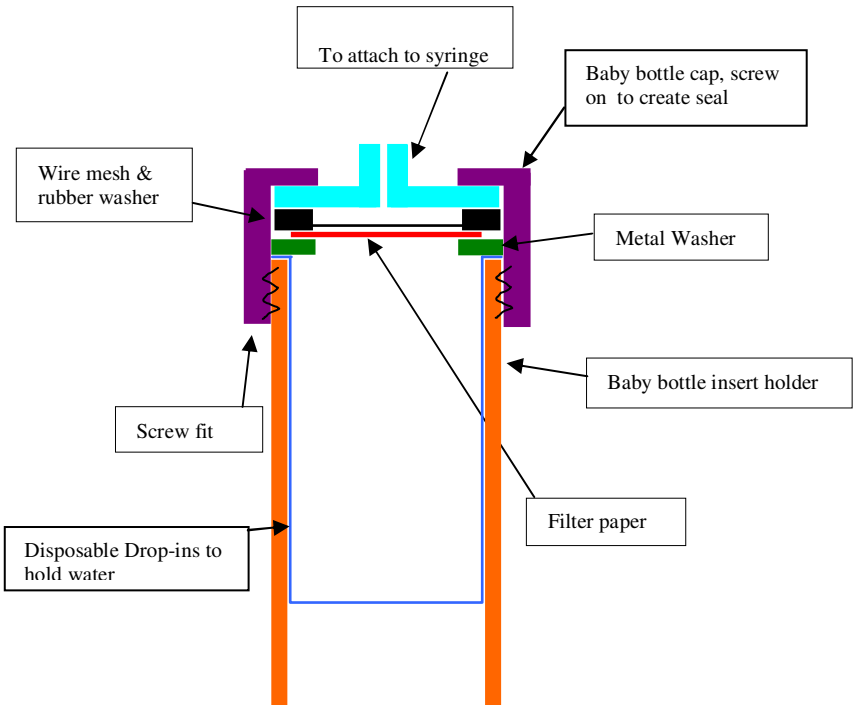
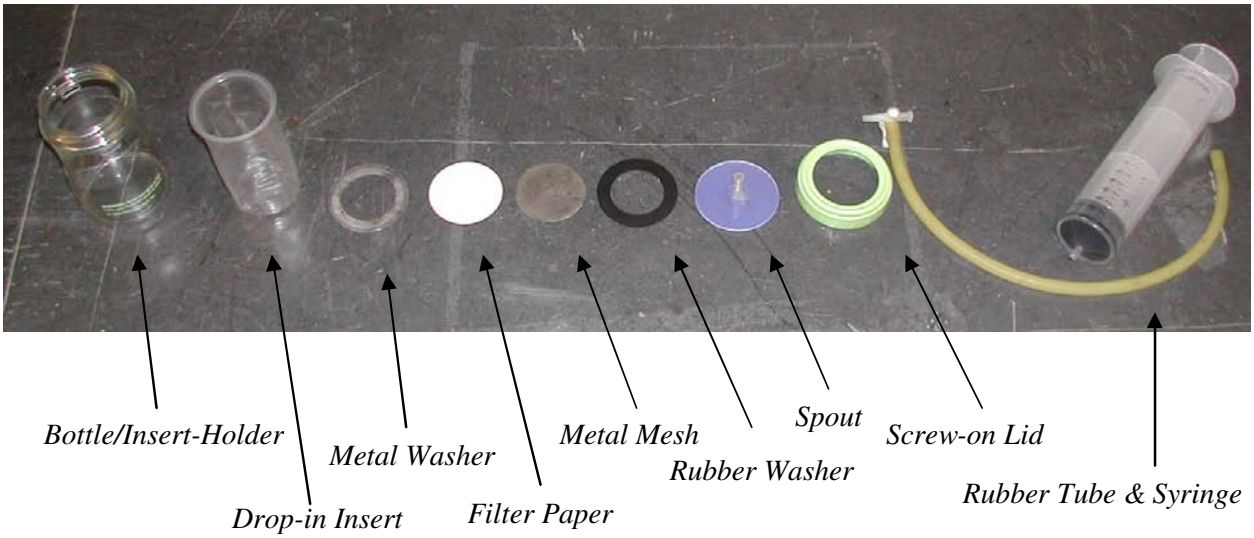
Low-Cost Water Testing Apparatus

MIT Design that Matters
Spring 2004
TestWaterCheap Team
(Four anonymous students)



Design Schematic of Test Water Cheap Filter Holder



Steps to membrane filtration using the Test Water Cheap design.

Preparation:

1. Pour a small amount of alcohol (isopropenol) into a shallow dish or plate, deep enough to submerge the washers and metal mesh. (This will need to be replenished occasionally if testing for a long period of time, since the alcohol will evaporate. Replenish when the flame on the washers dipped in alcohol does not cover the entire washer.)
2. Light a candle, which is the easiest flame source for this method since things need to be sterilized often. (Note: when holding things over the flame to sterilize them, hold them *above* (not *in*) the visible part of the flame. This will prevent soot from covering the equipment and thus the filter paper. If soot does accumulate, you can wipe the parts with a paper towel.)
3. If available, set up a ring stand to hold the baby bottle upside down.
4. Attach one end of the rubber tubing to a luer lock, which attaches to the syringe. Slide the screw-on lid onto the other end and attach the spout.

5. Wipe the spout, the inside of the screw-on lid, and the top rim and threads of the bottle with alcohol to clean/sterilize them before starting.
6. Prepare a Petri-dish (this may be done a few at a time):
    - Using a thin permanent marker, label the bottom of the dish (the side that fits *inside* the other half of the dish) with your initials, the date, the sample identification, volume of water tested, and any other information needed to distinguish the tests from each other.

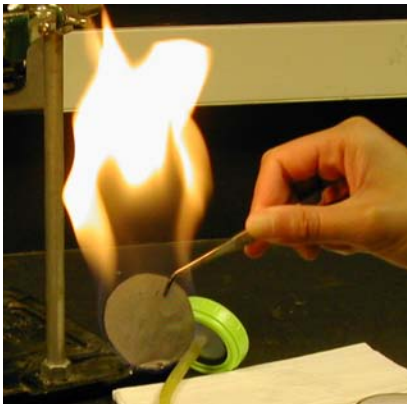
- Turn the dish right side up and open it (with sterile hands). Squirt 2-ml of testing broth onto the absorbent pad (which should be laying on top of the labeled side). Avoid squirting the very last bit of broth, which will dispense bubbles. Be sure to cover the entire pad with broth. If there is a large amount of excess broth at the bottom of the dish, carefully pour it out, making sure to leave one large drop of broth in the bottom. Close the Petri-dish.

Testing:

1. Rub hands with anti-bacterial hand sanitizer.
2. Remove a sterile insert from the box of inserts without touching the inside or top rim. Drop the insert into the rigid plastic bottle/holder.
3. Pour at least 75 ml of the water sample (or a dilution) into the disposable insert.

4. With tweezers, dip the metal washer into alcohol and hold it over a flame until the alcohol catches on fire. Wait for the all the alcohol to burn off (some liquid may be left on the washer, as isopropenol is usually diluted with water), making sure to hold the flaming washer over an inflammable surface, as flaming alcohol sometimes drips off the washer. (The washers and mesh may be placed to rest in the alcohol during testing to prevent them from being laid on a dirty surface.)
5. Place the metal washer on top of the disposable insert, using tweezers.
6. Rub hands with anti-bacterial hand sanitizer (be sure to do this at least once per test, perferably before openning the filter paper package).
7. Open a filter paper package by pulling back the tabs (uncovering about half of the filter paper), folding them over, and holding them against the package *without touching* the filter paper or the blue paper(s) protecting the filter paper. (Once you have touched the inside of the package flaps, do not let them flip back and touch the papers inside the package.)
8. Sterilize tweezer tips (as in step 4).
9. Slide the filter paper out of its package with the tweezers and place it grid-side down on top of the metal washer. Center the filter paper as much as possible.

10. Sterilize the metal mesh by dipping in alcohol and flaming.



11. Place the mesh on top of the filter paper. Center the mesh as much as possible (use 2 sterile tweezers if necessary). The better the mesh is centered, the better the lid will seal.

12. Sterilize the rubber washer by dipping in alcohol and flaming.
13. Place (and center) the rubber washer on top of the mesh.

14. Place the spout and screw-on lid on top of the rubber washer and screw the lid tight to seal the elements.
15. Invert the baby bottle and hang it on a ring stand, if available.
16. Vacuum-pull the water out with the syringe until all the water is gone (until no water can be visually seen rolling around on top of the filter paper). Try to avoid completely collapsing the disposable insert onto the filter paper.

17. If mostly air comes through when you pull with the syringe, try turning the baby bottle upright and carefully unscrewing and rescrewing the top. If this does not work, unscrew the top and try to re-center all four elements on top of the baby bottle with 2 sterile tweezers. Try to lose as little water as possible during these adjustments. If these steps continue to not fix the problem, you may need to trim the mesh to a smaller size. Do this with sharp scissors and ensure that the edges are flat afterwards, not sticking up (which generally occurs with dull scissors).
18. When all the water has passed through the filter paper, turn the bottle upright, unscrew the top, and carefully remove the spout, making sure that the filter paper and mesh (which will stick together) stay on top of the baby bottle and do not fall off.
19. Open a Petri dish so that the filter paper may be placed inside it.
20. With sterile tweezers, remove the filter paper (you may need to grab the mesh with one pair of tweezers and remove the filter paper from it with another pair). Place (and carefully center) the paper grid-side up into the bottom of the Petri-dish with a rolling

motion (to avoid trapping bubbles of air underneath). Make sure that the paper is lying completely flat in the dish. If one edge of it is up on the side of the Petri-dish, carefully adjust it with sterile tweezers, but touch *only the edge* of the filter paper. Close the Petri dish.

21. Repeat steps 1-20 for each sample. (Do not reuse the drop-in inserts unless the first test was a "blank test.")
22. At least every 20 minutes, stack the completed Petri dishes (making sure they all face the same direction) and strap them together with tape. Place them *upside down* in the prepared incubator (labeled side up). (This way, when condensation drips down, it doesn't smear colonies.)
23. Remove them after the specified amount of time (24 hours if using mColiBlue-24 broth) and count the number of colonies.
24. Dispose incubated and counted Petri-dishes by squirting a 10% chlorine solution (you can dilute Chlorox bleach) into the Petri dish, replacing the cover, and throwing in the disposal pail.

EC.701J / 11.025J / 11.472J D-Lab I: Development
Fall 2009