**Building an ISB Classroom Aquaponics System**

Below are the directions for building an aquaponics system using the Institute for Systems Biology design composed of a 19 gallon fish tank and a 6 ft2 grow bed. The system can easily be modified to have different fish tank and grow bed sizes depending on available funding and classroom space. When building a system of a different design, keep the ratio of fish tank size (# of gallons) to grow bed size (square feet of grow space) as close to 1:1 as possible. Our designs are examples of a “raft” or “deep water culture” method, which we recommended for classroom use. For more information about aquaponics, please visit our website http://baliga.systemsbiology.net/aquaponics/.

Preparing the Raft (Styrofoam):

**Materials:**

1. 2” thick foam board insulation

2. Drill

3. 2” circular drill bit

4. Measuring tape

5. Pen

6. Retractable box cutter

**Preparation:**

1. Cut foam into a rectangular shape that fits interior of grow bed (20” x 30”). It should float on water inside the bed when completed.

2. Draw a grid on the insulation piece to space plants. Plants can be spaced closer together in Aquaponics than traditional soil techniques due to constant nutrient flow throughout the water. Plants with a smaller adult diameter can be spaced closer together than large-diameter plants.

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3. Use a 2” drill bit to drill holes for net cups. If using net cups of a different size, draw circles around cups and cut holes with a box cutter.

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4. On short ends of raft, cut out a 3-4” half circle area for PVC to enter and exit the grow bed.

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Preparing the Grow Bed:

**Materials:**

1. Concrete mixing tub (20 gallon)

2. 1 – 1” threaded bulkhead fitting

3. 1 – 3/4” threaded bulkhead fitting

**Preparation:**

1. Drill 1 ¾” hole in side of grow bed at water level (as high as possible). Use the Styrofoam insulation as a guide to see how high or low to place the hole.

2. Drill 1 ½ ” hole in the opposite side of grow bed at the same height

3. Connect corresponding bulkhead fitting on either side of the grow bed wall.

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Preparing the Piping:

**Materials:**

Note: All joints should be connected using silicon caulk and Teflon tape.

1. ~7 ft each of ¾” and 1” black vinyl tubing (length will depend on distance between your grow bed and fish tank)

2. ¾” and 1” insert threaded elbow fittings

3. 6 each of ¾” and 1” hose clamps

4. PVC cutter

5. Silicon caulk

6. Teflon tape

7. Zip ties

**Preparation:**

1. Thread insert threaded elbow fittings into corresponding bulkhead fitting (don’t forget the silicon glue and Teflon tape!). The ¾” piping will be used to pump water from the fish tank into the grow bed, so attach this end to the water pump in the tank.

2. 1” piping will be used to gravity feed the water from the grow bed back into the fish tank.

3. The amount of pipe needed will depend on the distance between your grow bed and fish tank. Any supportive table can be used, but remember, just 5 gallons of water weighs 42lbs!

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4. Zip ties can be used to secure the vinyl water outlet feeding water back into the fish tank to the side of the fish tank wall.

\*\*\*\*\*\*Because vinyl tubing will be submerged in water in the grow bed and fish tank at the same time, the water will siphon back into the lower chamber (the fish tank in our case) until the water level is below the outlet in the grow bed fi the pump is turned off. Be sure there is enough space in the fish tank to allow the excess drainage when the pump is turned off (on purpose or if the power goes out on accident) otherwise the fish tank will overflow!\*\*\*\*\*\*

Preparing the Pumps and Aerators:

**Materials:**

1. Rio Plus 1700 Aqua Pump (6 foot head)

2. ActiveAqua Air Pump 3.2L/min

3. 2 – 6” air stones

4. Black silicon airline tubing

5. Airline holders (optional)

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**Preparation:**

1. Assemble the Rio Plus water pump as shown in directions. Use the flow regulator to decrease flow rate until water level is maintained (same as rate of water flowing out due to gravity). You will likely have to adjust this while the water begins cycling the first day.

2. Place water pump at bottom of fish tank (see next page under preparation of fish tank for picture).

3. Connect air stones to silicon tubing and place 1 air stone each in the grow bed and fish tank.

4. Place air pump **outside** of water on table/bench.

Preparing the Net Cups:

**Materials:**

1. 2” net cups

2. Clay media

3. Coconut media

**Preparation:**

1. Rinse clay pellets to remove dust

2. Make 1:1 mixture of clay pellets and coconut media

3. Fill net cups to top with mixture and place net cups in raft holes

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Preparing the Fish Tank:

**Materials:**

1. 19 gallon tub

2. Nitrifying bacteria

3. Chelated iron

4. Water testing kit

**Preparation:**

1. Tank should be placed below grow beds as water needs to flow back to fish tank via gravity

2. Pump should be placed on end of tank corresponding to ¾ “ vinyl tubing coming from grow bed

3. Nitrifying bacteria, water testing kit, and iron will all be used as system begins working. Bacteria and ammonia source (typically fish) will be used to begin the nitrogen cycle. pH, ammonia, nitrite and nitrate must be regularly tested as water cycles. Iron chelate can be added if plants show signs of iron deficiency (yellow leaves).

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Preparing the Lights:

**Materials:**

1. T5 fluorescent bulb and ballast

2. Scrap wood

3. Flat corner braces and screws

4. T5 fixture link cords

**Preparation:**

1. Attach bulbs to fixture. A more cost-efficient option is building a wooden fixture and attaching ballasts with screws.

2. Link the T5 lights together using link cords. Doing this, only one electrical socket will be needed.

3. Hang lights far from plants (at least 4-5 feet if possible).

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