1st Edition

The Do-It-Yourself Home Aquarium

- Design, Build and Enjoy Your Own Fresh or Saltwater Aquarium

J. K. Thomson

Why Not Build It Yourself?

Wouldn't you rather build an aquarium system to your liking and save hundreds of dollars in the process? Wouldn't you rather put more of your money into the fish than the equipment? This manual may be the answer you've been looking for!

Included are detailed step-by-step instructions to build essential items for the home aquarium. Whether you are an expert aquarist or just a beginner, this manual is for you.

You will discover how easy it is to build and implement:

* The Aquarium
* The Aquarium Stand
* The Aquarium Hood and Strip Light
* Reef Rocks
* Reef Food
* The Wet/Dry Filter (Sump)
* The Protein Skimmer
* The Water Chiller
* The Limewater Doser
* The pH buffer

The Do-It-Yourself Home Aquarium is the key to get inside the door to this fascinating yet expensive hobby.

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Design, Build and Enjoy Your Own Fresh or Saltwater Aquarium

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INTRODUCTION

Maintaining a home aquarium has been one of the most fascinating and rewarding hobbies I have been involved with. If you are money-conscious like I am, you will understand my motivation for writing this book. After many trips to local pet shops, I became increasingly frustrated with the limited selection and high prices for equipment that only partially filled my needs. You may have discovered that with this hobby comes a high price tag. I wanted to find a way to satisfy my needs without taking out a second mortgage. While in the pet store observing some outrageously priced piece of plastic, I would often think to myself, *I bet I could make the same thing for a fraction of the cost.* I started to experiment with some ideas and soon found out that I was right. Not only did I save a lot of money by making my own things, I attained a great sense of satisfaction knowing that my equipment functioned just as well as the equipment I could have bought at the store. In the process I also discovered that building the equipment itself was quite fun.

This book is written for the beginner and the expert alike. I don't expect that you will construct all the projects I've included here or even that you will want to. The bottom line is that if you construct just one of the projects listed you will have more money to spend on the fish and other things you choose to include in your aquarium. Each section is set up in basically the same way: a brief introduction is followed by required tools and materials lists and then a plan of procedure.

Be aware that experimentation is not only allowed but encouraged. If a project doesn't quite fit your needs, feel free to change things around until it does. All of these projects have been tested and have proven safe for the home aquarium. However, the author cannot be held responsible for any damage that may result to property or livestock as a result of any project in this book.

1. THE AQUARIUM

First up and most important is the aquarium itself. I will warn you up front that this is the most ambitious and time consuming project in the book. If you have experience using power tools you should have no problem building an aquarium. If you don't, it may be a larger project than you are ready for. If you fall into this category, I suggest you purchase the aquarium and let the savings from other projects in the book make up for it.

A benefit of making your own aquarium is that you can make it just about any size you like. This way you can choose the perfect size that will fit in the exact spot you have available. I have included plans for a 55 gallon aquarium but of course you can take the liberty of changing the dimensions to fit your needs. The one precaution to follow is that if the aquarium height exceeds 18 inches, I recommend using ½-inch glass rather than the ¼-inch glass.

To calculate the number of gallons your tank will hold, simply divide the volume of the tank in cubic inches by the number 231 as there are 231 cubic inches in 1 gallon. The dimensions for this tank will be 48 inches long, 14 inches wide, and 18 ¾ inches high.

1.1 TOOLS REQUIRED

- (1) portable or table power saw
- (1) automatic screw driver with Phillips bit
- (1) power sander
- (1) carpenters square
- (1) caulking gun
- (4) 4-inch paint brushes, one for each day of painting
- (2) 16-inch supports (or anything of this approximate height, such as boxes, used to support the plywood pieces during construction)
- (6) containers for mixing glue, putty, and paint

1.2 MATERIALS LIST

- (1) 4-foot by 8-foot by 3/4-inch sheet plywood (oak is recommended
- (1) 48-inch by 17 3/4-inch by 1/4-inch plate glass
- (100) 2-inch drywall screws
- (1) container waterproof glue
- (1) gallon autobody putty with hardener
- (2) gallons two-part epoxy paint
- (2) tubes with silicon caulking, non-toxic aquarium suitable
- (1) gallon Xylene glass cleaner
- (1) pint commercial glass cleaner
- (3) sheets 120 grit sandpaper
- (2) sheets 220 grit sandpaper
- (2) packs paper towels

1.3 PLYWOOD CUT LIST (cut from 4x8 sheet listed above)

- (1) 14-inch by 4-foot (bottom panel)
- (1) 18-inch by 4-foot (back panel)
- (2) 3-inch by 4-foot (upper & lower face frames)
- (2) 3-inch by 12-inch (left & right face frames)
- (2) 18-inch by 12 1/2-inch (end panels)
- (1) 5-inch by 12 1/2-inch (top brace)

1.4 TANK CONSTRUCTION PROCEDURE, TANK ASSEMBLY

a. Before starting, read through and make sure you understand completely all the instructions for this project. Inspect all plywood pieces for rough or flawed edges. Sand and apply putty as needed to get smooth flat surfaces.

b. Lay bottom panel on the 16-inch supports. Apply a generous amount of glue along all four edges of bottom panel, heavy enough to accommodate the edges of the back panel, end panels, and face frame. Use a brush to even out the glue so it doesn't drip.

c. Apply a generous amount of glue to the edges of theback panel and side panels, smoothing out with the brush. Turn bottom panel over, glue side down, centered on supports so that all edges of bottom panel are accessible.

d. Using the screwdriver, screw back panel to bottom panel, inserting 2-inch drywall screws at 3-inch intervals along entire length. Make sure that all screws are fully sealed and tight, slightly below the surface of the plywood. Make sure the pieces form a 90 degree angle.

e. Apply glue along 1-inch edge of each side panel and to the side which will contact the back panel. Apply glue to the back panel where it will contact the side panels. (See Figure 1.1a)

f. Raise each side panel up under bottom panel, and screw tightly to both bottom panel and back panel again placing drywall screws at three inch intervals.

g. Apply glue along inside edge of the lower face frame. Raise lower face frame up under remaining edge of bottom panel, and screw into place to bottom panel and side panels using 3 screws on each end and the normal 3-inch intervals along the length. (See Figure 1.1b)

h. Insure that all edges are flush and tight after final tightening of screws, and check for squareness. Turn tank right side up on sup ports for inspection. At this point, all panels screwed together should rest on the bottom panel, for the strongest possible base.

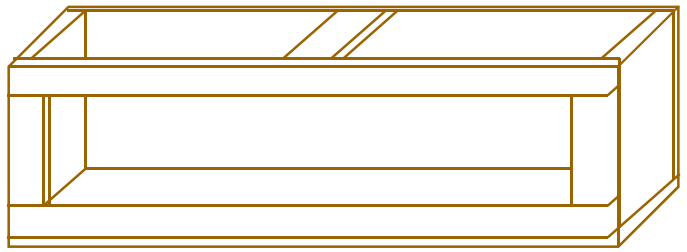

Figure 1.1

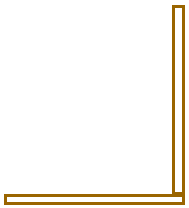

Figure 1.1a
Screw back to bottom

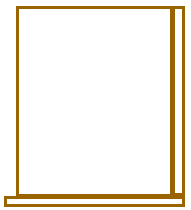

Figure 1.1b
Screw ends to both bottom and back

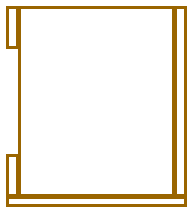

Figure 1.1c
Screw front frame to ends and bottom

i. Turn the tank face-up on the stanchions. Apply glue to FRONT exposed edges of side panels. Make sure you wipe off all excess glue while it is wet as it will be very difficult after it has hardened. Lay upper face frame in place and screw to edge panels, using three screws in each end. (See figure 1.1c)

j. Check short face frame pieces for proper fit, sanding if necessary. Allow a very thin area for the glue. Apply glue to ends of short face frame pieces. Lay short face frame pieces into place, and screw firmly to side panels, insuring that the outer edges are flush with the ends of the tank.

k. Recheck all work, wiping away excess glue. Insure that corners are square. Allow it to dry overnight.

1.5 PAINTING THE TANK

WARNING: APPLY PAINT IN A WELL-VENTILATED AREA, PREFERABLY OUT-OF-DOORS. THE FUMES ARE HIGHLY TOXIC AND MAY RESULT IN SERIOUS RESPIRATORY PROBLEMS IF THEY ARE CONCENTRATED AND EXPOSURE IS PROLONGED.

a. Apply epoxy paint to all exposed wood surfaces of tank. Make coat of paint as thin as possible, while covering the wood surfaces completely, because the paint runs easily. Allow coat to dry overnight.

b. Fill all cracks and holes with autobody putty, making as smooth a surface as possible. Sand entire surface, using 120-grit paper or power sander.

c. Apply second coat, again insuring that the coat is as thin as possible, to avoid running paint. Allow to dry overnight.

d. Use the 120-grit sandpaper for sanding the second coat of epoxy paint.

e. Repeat painting, drying, and sanding until 4 coats of epoxy paint are applied, substituting 220-grit sandpaper for sanding the third coat, in preparation for the fourth or final finish coat. (If power sander is used then the sanding pressure applied should be less for the last coat.)

f. Allow tank to dry in well-ventilated, warm area for 24 hours before proceeding.

1.6 INSTALLING THE GLASS

a. Turn tank face down on level, flat surface, insuring that entire face frame is supported.

b. Use 220-grit sandpaper to rough up a two-inch strip of the epoxy paint on the inside of the tank, around the glass opening. This rough area will serve as a bonding area for the silicon glue.

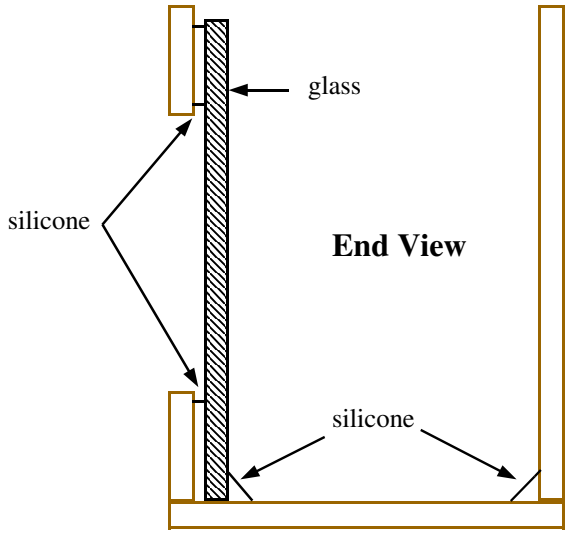

Figure 1.2

c. Sand or file all corners of the glass panel, to avoid later injury to either workers or fish. Clean entire surface and edges of glass panel with Xylene cleaner, and then commercial glass cleaner.

d. Apply a 1/2-inch bead of silicon caulking around entire opening in face frame, on inside of tank. The bead should be approximately 1 inch from edge of opening, except along the top, where the bead should be approximately 1/2 inch from edge of opening.

e. Install glass on inside of tank, insuring that the lower edge of the glass is resting full-length against bottom panel of tank for support. Press evenly on glass to remove all bubbles and gaps from silicon caulking seal.

f. Recaulk glass along all edges, pressing caulking with finger firmly into the corner formed by glass and face frame. Final caulking seal should be smooth, rounded, and free from gaps and bubbles. Wipe any excess caulking away after seal is finished.

1.7 FINAL FINISH

a. Using three screws for each end of brace, install tank top brace, centered, spanning from the top, inside edge of the back panel to the top inside edge of the upper face frame.
b. Apply heavy bead of silicon caulking into all interior corners of tank, again smoothing the seal with finger, removing all gaps and bubbles, and wiping away excess caulking when finished. Allow tank to dry for 48 hours in warm, dry area before adding water.

The only sealer/coating that is suitable for use in an aquarium is a two part epoxy for potable water tanks.

Solvents and thinners are not recommended for use with this epoxy because they would defeat the purpose of using a non-toxic coating. This potable water epoxy may cost a little more than a different coating but it won't poison your fish. I advise against using a tank liner, such as enamel, acrylic enamel, urethane, fiberglass, gel coat or polyester resin. All of these may release volatile organic compounds into the water. Only the interior of the tank which will touch the water requires the epoxy. If you want to save a little bit on paint, you can paint the exterior with almost anything you choose. ENJOY!

2. THE AQUARIUM STAND

Doing this project yourself will probably save you more money than all of the other projects in the book combined. I am continually amazed at the high prices pet stores charge for aquarium stands. Companies can get away with overpricing stands because they are specialized furniture pieces, and customers don't have many other options. That is where this book steps in. In this chapter, I will outline how to make a stand to support a 55 gallon aquarium. You can adapt the plan to suit your needs. This plan includes an open back, to allow easy access to power outlets and running air and water lines to and from the aquarium.

2.1 TOOLS REQUIRED

- (1) portable or table power saw
- (1) automatic screw driver with Phillips bit
- (1) power sander
- (1) carpenters square
- (1) handsaw and miter box
- (2) 16-inch supports (or anything of this approximate height, such as boxes, used to support the plywood pieces during construction)

2.2 MATERIALS LIST

- (1) 4-foot by 8-foot by 3/4-inch sheet plywood (oak is recommended)
- (1) 4-foot by 4-foot by 1/4-inch sheet plywood
- (100) 2-inch drywall screws
- (1) container wood glue
- (1) gallon wood stain or paint
- (2) paint brushes
- (3) sheets 120 grit sandpaper

- (1) gallon water sealant
- (1) 16-foot wood trim (pre-routed, approx. 1 3/4-inch in width)
- (2) 17 1/2-inch by 26-inch cabinet door faces (can be special ordered at most hardware stores, or you can make them yourself)

2.3 PLYWOOD CUT LIST

- (2) 16-inch by 50-inch (bottom and top panel)
- (3) 15 1/4-inch by 28-inch (widthwise support panels)
- (2) 5-inch by 28-inch (front lengthwise support panels)
- (1) 6-inch by 28-inch (front center lengthwise support panel)]

2.4 STAND CONSTRUCTION PROCEDURE

a. Before starting, read through and make sure you understand completely all the instructions for this project. Inspect all pieces for rough or flawed edges. Sand as needed. Make sure all boards are square.

b. Refer to Figure 2.1 for a visual of how the bottom, top, and supports fit together.

c. Lay out board for bottom panel. Mark a pencil line where the center support will stand. Attach widthwise support panels one at a time. First, apply a generous bead of glue along the width of the bottom panel where the board will be attached. Second, flip the board over on top of a stand so the glued face is facing downward. Third, attach the widthwise support at a 90 degree angle and press the bottom piece down firmly. The widthwise support should be placed flush with the back of the bottom panel leaving a 3/4 inch space at the front of the assembly where the lengthwise support panels will be attached later. Fourth, insert the wood screws at approximately 3 inch intervals along the width on all of the widthwise supports.

d. Take care as you move the assembly so you don't damage one of the joints as they will not be very well supported. Get another person to help you and turn the assembly face up again. Attach the lengthwise supports one at a time. Apply glue to the bottom panel and to the length of the widthwise supports where they will contact the lengthwise supports. Insert at least two screws through the bottom panel into each lengthwise support. It is important to use two or more screws, rather than just one, to keep the panel from pivoting.

e. Check to see how square the boards are at the top of the assembly and check the height of the widthwise supports against the height of the lengthwise supports. It is inevitable that you will have a few inconsistencies. Use rough sandpaper to bring all boards to exactly the same height. Be careful not to round the corners. You can check your work by setting the top panel on top of the assembly and making sure there is no rocking or gaps between the boards.

f. After you are satisfied that everything is perfectly flush, attach the top panel. Apply a bead of glue to all edges that will make contact with the top panel. Insert screws along 3 inch intervals around the entire top. Be sure to put at least two screws into the lengthwise supports. Make sure that the screw heads are slightly recessed into the board so they won't create pressure points on the bottom of the aquarium. Pressure points could cause your aquarium to crack and leak when you fill it with water.

g. Take a minute to inspect your work. Make sure there are no irregularities in the wood or the way in which it fits together. All angles should be exactly 90 degrees. Fill in the indentations left by the screws on the top panel with wood putty, wait for it to dry, and

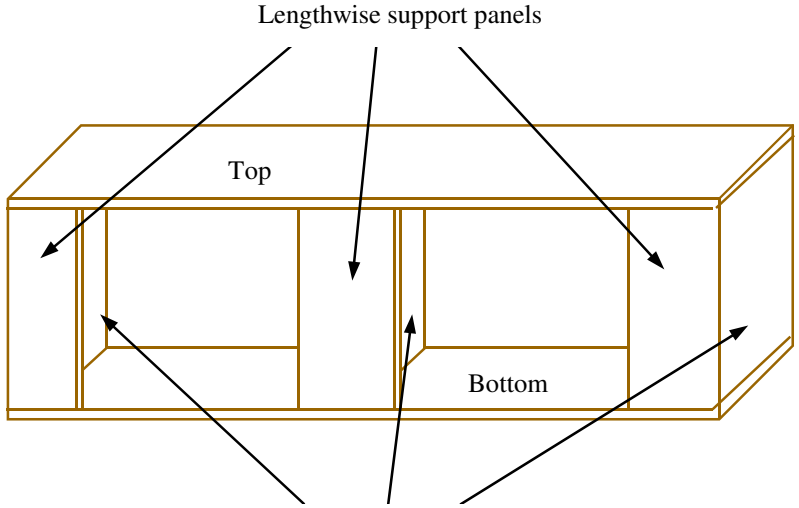

Figure 2.1

then sand smooth. (See figure 2.2)

h. Attach the wood decorative trim around the top and bottom of the assembly. Use the miter box to cut the corner pieces at 45 degrees each. A piece of sound advice: measure twice, cut once. Attach one piece of trim at a time with glue or nails. Going too fast on this part could lead to uneven joints. Use clamps to hold the pieces in place so they won't slide. The trim should hang down over the edge of the board by approximately one inch. Allow to dry overnight.

i. Attach the cabinet doors using two hinges per door. Attach the hinges to inside edge of outer lengthwise support boards. The doors should overlap the middle support board by one half inch on either side. They should be slightly less than flush with the decorative trim on the top and bottom (See Figure 2.3)

j. Sand the entire assembly with a fine grit sandpaper.

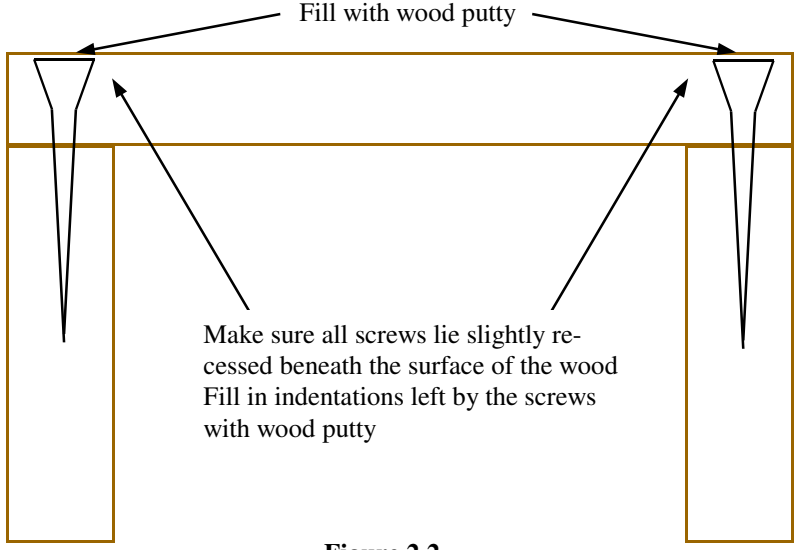

Figure 2.2

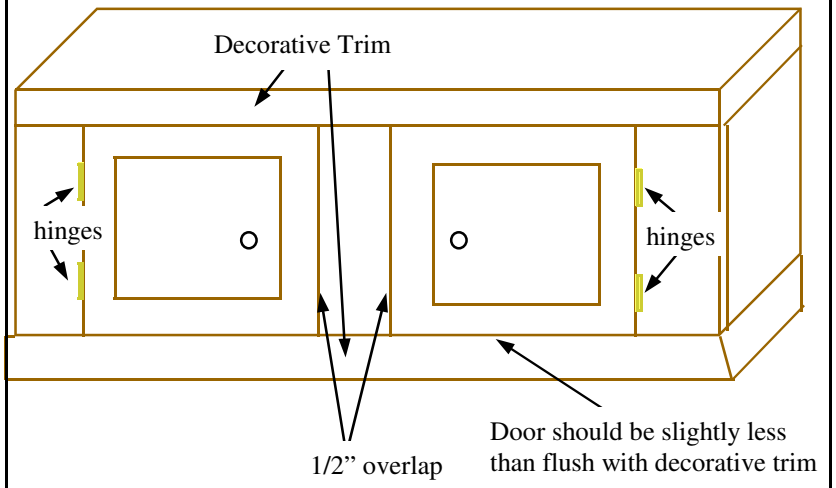

Figure 2.3

k. At this point you can paint the stand, stain it, or apply just the water sealant if you are after a more natural look. Apply paint, sealant or stain in a well ventilated area, preferably in the outdoors. If you are staining or painting, apply three coats of stain allowing each coat to dry completely before adding the next. After it is completely dry, apply two coats of a water sealant. Allow to dry completely and ENJOY!

3. The Aquarium Hood and Strip Light

If you purchased your aquarium chances are you already have a hood and light. If not, it is simple and inexpensive to make your own. Since this project involves electricity you should exercise extra caution while building this project as there is potential for disaster any time you are working with both water and electricity. If you are unsure of your abilities, it is better to purchase a professionally made piece of equipment than to take the risk of electrocution or fire because of poor workmanship.

3.1 TOOLS REQUIRED

- (1) hacksaw
- (1) wire cutters

3.2 MATERIALS LIST

- (1) vinyl rain gutter purchased at Home Depot or similar outlet
- (2) end caps for rain gutter material
- (1) standard, 2 tube, 40 watt ballast (for 48 inch tanks), 30 watt ballast (for 36 inch tanks), etc.
- (2) set pre-wired rubber end caps for fluorescent tubes
- (5) plastic tie-wraps
- (1) 3/4" black electrical tape
- (4) wire nuts (orange size)
- (1) roll aluminum foil
- (1) sheet plexiglass large enough to cover entire top of aquarium
- (1) tube glue
- (1) 3 pronged electrical “lead out” cable 5 feet in length
- (2) fluorescent bulbs

3.3 HOOD AND LIGHT STRIP CONSTRUCTION

a. Build the cover panel by cutting two matching pieces of plexiglass that will rest on either end of the aquarium and also on the support beam in the middle of the aquarium. Build an access door by cutting a rectangle out of either or both sheets and reattaching with hinges or transparent packing tape. Glue a knob of on top of the hinged door with waterproof glue.

b. Cut the rain gutter material with the hack saw to the length of your tank MINUS the additional inch or so the two endcaps occupy.

c. Install the end caps onto the gutter. Apply a small amount of glue to each cap and snap it into place onto the ends of the gutter.

d. Apply a small layer of glue to the entire inside of the assembly and cover with aluminum foil (see Figure 3.1).

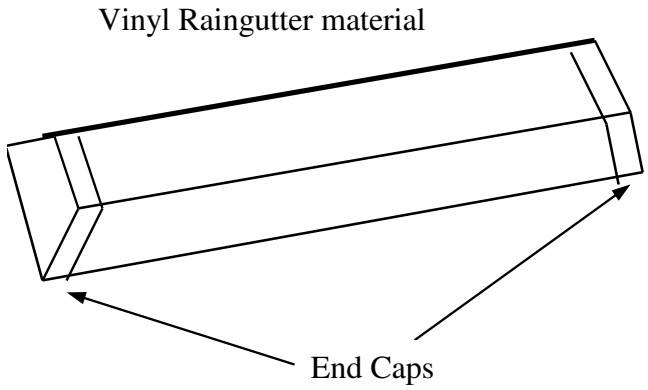

Figure 3.1

e. Rest the assembly on top of the hood and make sure it doesn't wobble. Follow instructions included with the light fixture to install pre-wired rubber end caps for fluorescent bulb into rain gutter assembly.

f. Drill a hole in the back center of the raing utter assembly just big enough for the power cable to pass through. Mount the ballast on the back of the assembly. Secure a nonflammable spacer between the ballast and the assembly as the ballast will tend to get quite hot after prolonged use.

g. Wire the ballast, the rubber end caps and the power cable together with the wire nuts as directed in the instructions that come with the ballast. MAKE CERTAIN ALL WIRES ARE ATTACHED PROPERLY (see Figure 3.2).

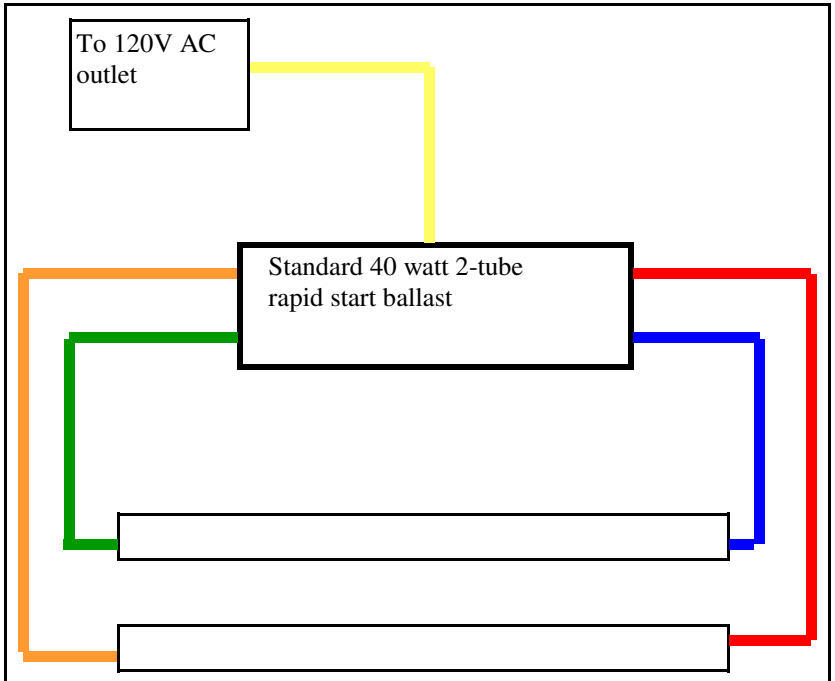

Figure 3.2

h. If you wish to use two bulbs rather than one you will need to purchase a ballast designed for two bulbs. Depending on the size of the rain gutter you should be able to fit both bulbs inside the assembly. It is best to purchase bulbs specifically designed for aquarium use. Matching a 50/50 flourescent bulb with an actinic blue bulb will yield the best results. This will insure that the essential spectrum and intensity needs of both fish and invertebrates will be met.

i. A good alternative lighting system to long fluorescent tubes that worrks well is to install two regular incandescent light fixtures inside the rain gutter assembly and purchase fluorescent bulbs manufactured for incandescent fixtures. This way you won't have to worry about where to attach the ballast.

j. Since there is a tendency for the fixture to get hot after prolonged use, it is a good idea to limit the time the fixture is continuously on. Purchasing an electric timer to automatically regulate the time the lights are on will save you a lot of hassle. Set the timer to a 2 hour on followed by a 1 hour off scheme throughout the day and leave the lights off through the night.

k. Plug it in and ENJOY!

4. Reef Rocks

Natural looking reef rocks can make the difference between a mediocre and a spectacular looking aquarium. If you live near an ocean you may be able to harvest your own reef rocks. If you don't, and cringe at the thought of paying someone upwards of $20 for a rock, why not make your own rocks? Reef rocks provide much needed shelter and hiding places for the creatures you introduce into your aquarium. Even if you have access to the ocean, you may find making rocks to fit your particular needs may be better than searching in vain for that perfectly shaped rock. You also do the reefs in the ocean a favor by not disturbing them.

If you want to introduce non aquatic rocks into your aquarium you do so at your own risk. Rocks found outside of the water environment can contain soluble minerals which can leach into your aquarium water and could potentially harm your fish. Anytime you introduce something foreign into your aquarium it is best to test it out in aquarium water you have set aside away from livestock for several weeks. Pay close attention to the water chemistry during this "quarantine" period. This is a project where you can really let your creative side show through.

4.1 TOOLS REQUIRED

- (1) Shovel
- (2) Plastic spoons
- (2) Plastic buckets
- (2) Styrofoam or heavy duty cardboard boxes

4.2 MATERIALS LIST

- (2) bags aragonite gravel, one fine grain, one course grain
- (1) bag #3 Portland cement
- Water
- Sand

4.3 MAKING THE MOLD

a. Fill the boxes approximately 1/3 full of sand. Dampen the sand just enough for it to be sculptable.

b. With the shovel and the spoons dig out a mold in the sand. If you want a tunnel rock for example, leave a mound in the center and dig out the sand around the base. Think in terms of negative space, anywhere you want rock to be, remove the sand. Be creative. You can make shelves or arches; just try to stay away from too much symmetry as it won't look as natural (see Figure 4.1).

4.4 MAKING THE ROCKS

a. Mix 6 parts aragonite gravel with 1 part portland cement

b. Add clean fresh water to this mixture. Try to keep it as dry as possible but yet wet enough to hold it's shape when you squeeze a handfull.

c. Add the mixture to the mold. Cover the top with more sand to insure uniform drying. You can work in layers, covering the rock partially with sand and making a new mold as you work your way up. Remember to make the base strong so it can support the

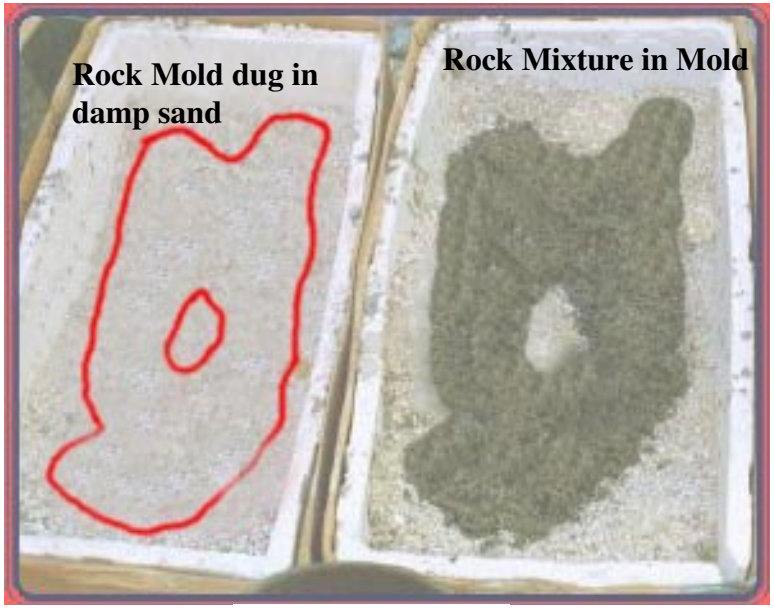

Figure 4.1

weight above it. Also, note that the thicker you make the rock the longer it will take to dry and to cure and the heavier it will be. If you want large rocks and want to keep the weight down, one suggestion I've heard but haven't tried is to add a bag of pasta macaroni to the mix. The pasta will dissolve during the curing process leaving behind interesting fissures and tunnels in which your creatures can hide. This also makes the larger rocks significantly lighter in weight.

d. Allow to dry for several days.

4.5 CURING CEMENT ROCKS

At this point you will be tempted to add the rocks straight to the aquarium. DON'T DO IT! You could have a water chemistry crisis on your hands if you don't allow the rocks to cure properly. The cement can release lethal amounts of calcium oxide and calcium hydroxide into the water. This would raise the pH of your aquarium water to dangerous levels.

If you don't have livestock in the aquarium yet you could cure the rocks in the aquarium, but I would recommend you cure the rocks in plastic buckets. The key to proper curing is changing the cure water solution often which is a lot easier if you use buckets. You need to allow at least four weeks (six weeks is optimal) of curing time before you introduce the rocks into your aquarium. To cure the rocks, completely submerge the air dried rocks into warm water. If you want to speed the process up a little bit add about a teaspoon of distilled white vinegar to each gallon of water. Agitate the water with a pump and an airstone. Change this curing solution daily if possible. Test the pH of the curing water each week (minus any vinegar) and don't add the rocks to your aquarium until it comes down below 8 to stay. Once the pH stays consistently below 8 in fresh water, add the rocks to saltwater and let cure for about three days more before you add them to your aquarium.

Do not add more than a few pounds of cured rocks to the aquarium at one time or you still may cause irreparable damage. The key is to monitor the aquarium pH very closely the first few days after a rock is added. If all appears normal you can continue adding the other rocks one at a time and monitoring the pH over several days.

In addition to affecting pH, another side effect of these homemade rocks is that they can increase the calcium content of the water to levels which could cause calcium precipitates to form. These can be a real mess to clean off of aquarium walls. On the upside, however, if you have corals in your aquarium the slow release of calcium from the rocks will be beneficial for them. If you properly cure the rocks, however, neither of these problems will be an issue for you. Patience is important here. Once you have all the rocks in place I recommend you buy a couple of "seeder" live rocks from the pet store to introduce various lifeforms. After a few weeks you should notice varied colored lifeforms colonizing on your synthetic rocks.

5. REEF FOOD

Based on the different types of creatures you have in your aquarium, you can customize a menu to meet their nutritional needs. In the process you will also save yourself a lot of time and money. This section is primarily for saltwater reef aquariums, but can be adapted to freshwater aquariums as well. Before you start throwing all kinds of new foods into the tank, be sure to test out small pieces to see if the fish will take it. This can help you avoid polluting the tank.

The best approach is to make up a food mixture about once a month that will feed everything in a reef tank simultaneously. What actually goes into the food mixture depends on what is available and the type of animals that are in the tank.

A list of possible ingredients is included below. The more herbivores there are, such as tangs, the more vegetable matter you put in, the more suspension feeders, the more small food particles etc. Adjust the menu to the needs of your reef. With experience, you will learn what foods you have success with. The great thing about homemade reef food is that there are so many different foods introduced into the aquarium with one feeding.

The easiest way to make reef food is in a blender. A bowl and electric hand mixer could also be used. Make sure though, that your mixture is not reduced to a really fine paste, or there will be no larger food particles for the larger fish in the aquarium. Use your judgment on which ingredients to add at a particular time in order to keep them from being liquified. A way to avoid this is to cut up some of the ingredients by hand and add them to the mix after it has been blended. It is a good idea to add a little water to help form a thick slurry. I have included other more specific tips in the ingredient descriptions.

Nori

This is dried seaweed, and herbivorous fish absolutely love it. When you buy it, it is in thin sheets, just a bit thicker than a sheet of paper and is a dark green color. Buy the plain version, not flavored. Blend all the other ingredients first, then add shredded nori to the mix at the end.

Shrimp

Shrimp is a good food for all carnivorous fish. A few larger pieces should be added to benefit larger fish, polyped corals and anemones.

Scallop

Scallops can be blended up into a really fine paste which is beneficial for supension feeders such as small polyped corals, fan worms etc.

Squid/Calamari

Squid is good for larger carnivorous fish. It can be somewhat rubbery and may not mix well in the blender. It's probably best to slice into small pieces using a knife and add it to the blended mixture.

Octopus

Use the small entire octopus variety. It can either be blended or cut up into pieces and added to the mix.

Fry Food

This is a small bottled product you can buy at the pet store that is used to start a culture to feed fry. It is a good food source for the fine suspension feeders, such as clams, sea squirts, etc.

Yeast

Yeast is a good fine suspension feeder food. Use in moderation.

Flake Food

This will ensure that your fish are getting all the nutrients they require. You won't need to blend it with the other ingredients. Add the flake at the end.

Bait Fish

Larger carnivorous fish love these. They are very inexpensive.

Brine Shrimp

Brine shrimp can be purchased frozen at most pet shops. You can also incorporate newly hatched brine shrimp. Brine shrimp "eggs" (actually cysts) are available at most pet shops. Follow instructions on package to start your own brine shrimp hatchery.

Fish Eggs

Fish eggs have a lot of nutritional value, I just wouldn't use the Russian caviar variety. Add whole eggs to the mix.

Chicken Egg Yolk

Cook the egg yolk, then just add to the blender. Add towards the end as it does not have to be cut up, just stirred in well. It is a good type of food for the suspension feeders as it will quickly break up upon injection into the aquarium. Use sparingly.

Bloodworm/Earthworm

These are great for carnivorous fish and are readily available at bait shops or your backyard. It is probably best to cut up into smaller pieces.

Spinich/Romaine Lettuce/Broccoli/Pea

Make sure your fish that will eat these sorts of things before you pollute the aquarium. Shred these up separately, then stir in at the end so that you have more control over the resulting size.

These ingredients will make a reliable and nutritious reef food. To insure that it stays fresh and lasts a long time, I suggest you freeze it. One strategy that I have found that works well is to freeze it in ice cube trays. Depending on the size of your reef, you can purchase an ice cube tray with compartments the size you need. If you can't find an ice cube tray that meets your needs you can always water it down before freezing. If you build the chiller that I have outlined later in the book you even have a convenient place to store the food away from your own refrigerator.

Usually one feeding per day is adequate. Place the frozen food into a small glass of water from the aquarium and allow it to thaw. Pour it directly into the aquarium. If you need to direct the food to specific organisms I recommend using a turkey baster to inject the food over the area you desire. Remember that you do not have to put all the ingredients in your reef food, these are just some examples of what you may put in.

6. THE WET/DRY FILTER (SUMP)

There are several benefits of using a wet/dry filter over other types of filters available today. Not only does it get the water cleaner, it also allows you to store all of the unsightly water treatment equipment out of sight in the cupboard below the aquarium.

There are 3 main components of a wet/dry filter system: prefilter, bio-tower and sump. The prefilter siphons water from the tank into the bio-tower. The prefilter also filters (as the name implies) the water prior to it coming in contact with the bio media. The bio-tower contains a diffusing mechanism and bio media, on which nitrifying bacteria colonize. The sump is nothing more than a small tank to hold water and other filter material which can connect to other things such as heaters, chillers, skimmers or chemical dosers.

The basic operation of the filter is as follows. The water flows from the prefilter to the bio-tower. The bio-tower spreads the water over a large area of bio media, which contains nitrifying bacteria. Dispersing the water acts to aerate the water and denitrify it. Denitrifying water refers to removing the ammonia that builds up in the water overtime. Ammonia is probably the most toxic chemical to your fish. The water drips through the bio media and collects in the sump. Carbon, buffers, zeolites or other media may be placed in the sump to aid in chemical filtration and long term stability. Anytime you need to medicate the aquarium water you can do it directly in the sump. This will dilute the medication making it less of a threat to overcome your fish as it is gradually added to the tank over time.

You will need to purchase a substantially powerful water pump for this to work. The pump must be able to pump water high enough vertically to reintroduce the water from the sump back into the aquarium.

6.1 PREFILTER

There are several different configurations for prefilters. The best prefilter arrangements are probably plastic filters connected to holes drilled

in the bottom or side of the aquarium. Drilling through glass is oftentimes risky business. A mistake while drilling your aquarium could render it entirely useless. In this book I am including plans for a dual overflow approach. If you have the option for a drilled aquarium I would recommend going with that. If you want to get your aquarium drilled, many pet shops provide this service for a small fee. I do recommend, however, that you do not drill it yourself.

Another method that works quite well is the dual overflow approach. This includes two overflow boxes, one inside the tank and the other outside. The inside box has a grate near the top which allows water to flow into the box and collect. The outside box has an outlet or bulkhead on the bottom to allow water to drain from the overflow to the bio-tower. The figure below illustrates the basic setup. A U-tube feeds water from the inside box to the outside box. The bulkhead is usually covered by some filter media, usually filter floss or some type of cloth designed to remove large impurities but not restrict water flow appreciably. This way the water is filtered prior to entering the bio media (see Figure 6.1).

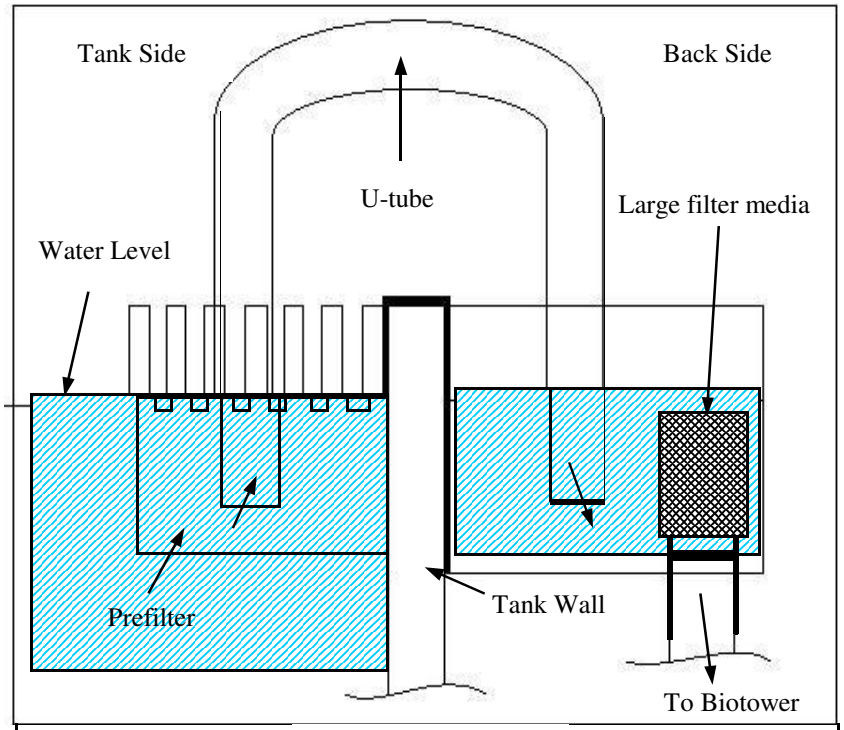

Figure 6.1

One advantage of the dual overflow construction is the way water flows to and from the rest of the filter. With the pump in the sump, water is forced into the tank from the sump, which in turn overflows into the inner overflow box. The U-tube feeds the water to the outside box and back to the sump. Should there be a power outage or a pump failure, the water will only drain from the tank until the level drops below the inner overflow inlet grate and then the siphon will be broken. Once the siphon is broken, no more water will flow to the sump. If the sump has enough extra volume to compensate for the extra water, no water will be spilled.

Construction of the overflow boxes require nothing more than a few pieces of acrylic and some acrylic bonding material. It is critical that the boxes do not leak. Speaking from sad experience, waking to find a few inches of saltwater covering the floor is not a pleasant experience. If you are willing to conduct some experiments, you can design and construct your own prefilter.

6.2 SUMP TANK

Construction of the sump body can be as simple a buying a small 5 or 10 gallon tank, or as complex as building one from whatever material you have available. The size of the sump is system dependent, but it should be large enough to hold all the water that will drain back into it during a power outage. The greater the sump space, the less the chance it will overflow during a power outage or if the pump fails.

6.3 BIO-TOWER

The sump and bio-tower are contained in one functional unit. The bio media fills the bio-tower and water drips down over the bio media from above into the sump area. There are various opinions about which method of dispersing the water is best, a drip plate or a rotating spray arm. A drip plate will clog with time, and a spray arm might stop rotating at times. A drip plate can be cleaned and kept from clogging and it is also easier to build, so that is what is included in this book. They may very well be replaced with a rotating spray arm.

The bio-tower will actually sit inside the sump, elevated slightly above the water level so the water can trickle into the sump holding tank. The bio-tower can be constructed from acrylic sheets glued together to form a rectangular box open on both ends. An easier more cost efficient method is to use a plastic bucket or trash can. Just make sure it will fit into the sump tank. Filter material or a protein skimmer can be placed under the bio-tower or in the direct flow path of the water as desired. Commercial bio-media costs about $20-$30. Homemade media which is usually just as effective can be just about anything you find around the house that has good surface area

and won't degrade over time. Examples include, cut straws, Easter basket grass, and plastic combs or brushes. Whatever media you settle on make sure it won't leach toxins into the water.

6.4 TOOLS REQUIRED

- Power Drill
- Acrylic material cutting blade
- Razor blade

6.5 MATERIALS LIST

- (1) 5 gallon plastic trash can
- (1) 12 inch by 24 inch by 1/4 inch acrylic sheet material
- Bio-media
- Waterproof acrylic glue
- (1) 1/2 inch diameter hose
- (2) 1/2 inch hose connector joints
- Sump tank

6.6 CONSTRUCTION

a. Cut two pieces out of the acrylic sheet, one to fit just inside the bottom of the trash can and one to fit snugly into the top of the trash can. Leave about one inch of space from the top of the trash can to the top of the upper drip plate. You may need to install hooks or screws to keep the upper drip plate from slipping down.

b. Drill 1/16" holes spaced about ½" to ¾" around the drip plates. On the upper drip plate, leave a 3" circular space in the middle of the plate where no holes are drilled. Also, leave a radius of about one inch from the edges where no holes are drilled. The box acts to collect water and allows it to evenly drip through all the holes in the drip plate. The area in the center is where the water will enter from the prefilter and splash down onto the drip plate. You don't want the water to be forced through just the center, so there are no holes there to allow the water to collect and distribute. The drip plate should be constructed of at least 1/4" acrylic so that it won't sag in the middle and unevenly distribute the water. The bottom drip plate should be drilled in the same way, but don't worry about leaving a space in the center.

c. Cut the bottom out of the trash can, leaving a 1/4 to 1/2 inch lip around the edge. Put the bottom drip plate in place and fill the trash can with the biomedia you have selected. Now put the top drip plate in.

d. Use another piece of acrylic plate to cover the bio-tower. The cover plate should have a hole cut in the center where you can attach an elbow and connect the outlet hose from the prefilter. Use a PVC elbow and coupler which has a slip fitting on one end and a threaded fitting on the other (most commercial prefilters will come with an elbow and coupler). The coupler should screw into the elbow and fit tightly against the cover plate. Use O-rings to ensure a good seal. The cover should have some sort of rests or blocks on it to keep it from sliding around. The blocks should fit just inside the drip plate box and make a snug fit to keep the cover from pulling out easily (see Figure 6.2).

f. Make sure that the hose fits well and doesn't leak. You may need to use hose clamps if you do detect a leak. Make sure that there are no

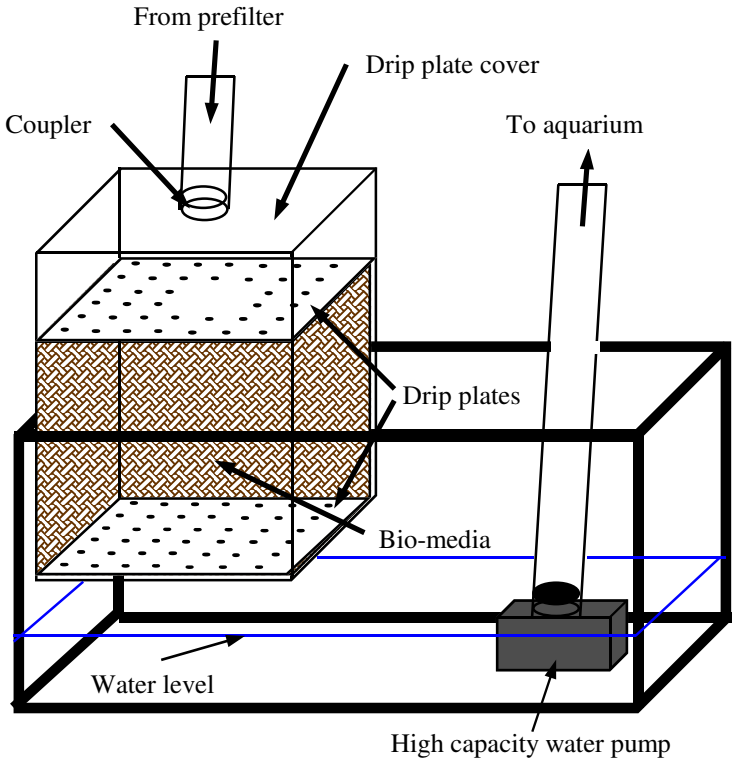

Figure 6.2

metal parts that will come in direct contact with the water so you avoid introducing toxins into the water.

g. Now place the assembly into the sump tank in the cabinet under the aquarium and make all the necessary connections. Once the system is set up, test the drip plate and adjust the size of the drilled holes to allow about 1 inch of water to collect. The size of the holes depends on the volume of water delivered from the prefilter. If the holes are too small the drip plate will overflow, if they are too large, it will run dry. Running dry is better than constantly overflowing. You will have to experiment with the size of the holes to meet your needs. Also, additional mechanical filter media (such as filter floss) can be placed over the drip plate for high quality filtration.

h. Next install the water pump into the bottom of the sump. Attach the water return line to the pump and then to the aquarium. The return hose should be positioned to empty slightly above the water level in the aquarium. If the pump fails or loses power, a backwards siphon could be set up and drain the aquarium if the end of the hose is submerged. I learned this lesson the hard way. Wet carpet smells very badly for weeks!

i. At this time you can also introduce hose lines from the sump to other equipment such as a protein skimmer or water chiller.

j. Once you feel comfortable that everything is in place and functions properly, start cycling the aquarium water through your filter system and back to the aquarium. Observe closely every facet of the setup. You don't want to make unpleasant discoveries later on. Check that there are no leaks in any of the tubing and connections. Watch the water level in the sump and make sure that it stays constant. Cut the power to the water pump and observe what happens. Be prepared to break the siphon just in case you've made an error in judgment. The siphon from the prefilter should eventually be broken as the water level in the aquarium falls below the intake cutoff. You can make adjustments to the height of the prefilter in the aquarium to control the siphon cutoff level. ENJOY!

7. The Protein Skimmer

The purpose of a protein skimmer is to remove organic wastes from the water before they convert to nitrates and other compounds which could be harmful to fish. Most conventional filters fail to remove these organic molecules. In saltwater tanks these wastes usually float on the top of the water. To remove these organic wastes we skim the surface water and then pass it through a protein skimmer. The separation of the waste from the water is achieved by forcing small bubbles through a column of water. For best results, the water flow should oppose the flow of the bubbles (i.e., bubbles flow upward as the water flows downward). Also, the smaller the air bubbles are in the column, the more efficient the separation will be. A skimmer consists of a column of flowing water, an air pump and a collection cap to trap the organic wastes pulled from the water. This particular model can be used quite well in conjunction with the wet dry filter we constructed in chapter six. Insert the skimmer in the tubing between the prefilter and biotower. In this way the skimmer is driven by gravity and you won't need to connect another costly water pump into the scheme. There are a number of different designs for protein skimmers. To suit the needs of a modest home aquarium, we will build a counter current air driven protein skimmer.

7.1 AIR DRIVEN PROTEIN SKIMMER

A Counter current air driven protein skimmer consists of nothing more than a long tube with water entering at the top and exiting at the bottom with an airstone in the middle of the tube. There are several modifications to this simple design but most are for convenience only. This particular model has been constructed with a removable collection cup to facilitate easy cleaning.

The length of the reaction tube is somewhat arbitrary, but one too small or too long will be less efficient. Sizes range from 12" to about 48". The reaction tube, collection cup and airstone cover are constructed from acrylic tube, and the rest is made of PVC and acrylic plating. We use acrylic tubing to allow us to see the reaction chamber in action. The disadvantages of using acrylic tubing is that it is considerably more expensive than PVC and may need a more frequent cleaning of the algae growth.

7.2 TOOLS REQUIRED

- Power Drill
- Acrylic material cutting blade
- Razor blade
- Tape measure

7.3 MATERIALS LIST

- Waterproof acrylic glue
- (1) 2.75" diameter by 30" length clear acrylic tubing
- (1) 1.25" diameter by 5" length PVC pipe.
- (3) 2.75" diameter plastic circular caps that fit acrylic tubing
- (1) 30" rigid airline tubing
- (1) high capacity air pump
- (1) basswood airstone
- (2) 1/2" rigid tube connectors

7.3 CONSTRUCTION

a. Cut and sand all pieces of acrylic and PVC according to Figure 7.1 until they are flat and smooth. It is critical that the edges are flat so they will make a good seal and won't leak.
b. Drill a 1.25" diameter hole in the center of two out of the three circular caps.
c. Place one cap on the 24" acrylic tube and the other on the 3" acrylic tube. Into the holes, insert the 1.25" by 3" PVC pipe and make sure it fits firmly. You may have to sand the holes or use a larger drill bit to achieve the proper fit. It's always best to start small and widen a hole rather than the other way around.
d. Glue the 1.25" by 2" PVC pipe to the center of the third 2.75" circular cap without the hole. Glue this cap onto the other end of the 24" tube. The top end should have a hole in the middle and the bottom one should not. Now take the 1.25" by 3" PVC pipe and glue just the lip of the pipe inside the hole of the upper disc. Do not glue the upper tube and cap assembly to the lower assembly. This will allow for easy removal and cleaning. Allow the assembly to dry completely. Drill 1/2" holes into the side of the lower assembly to accommodate the water in and water out lines. Glue the rigid tube connectors into these holes and allow to dry.

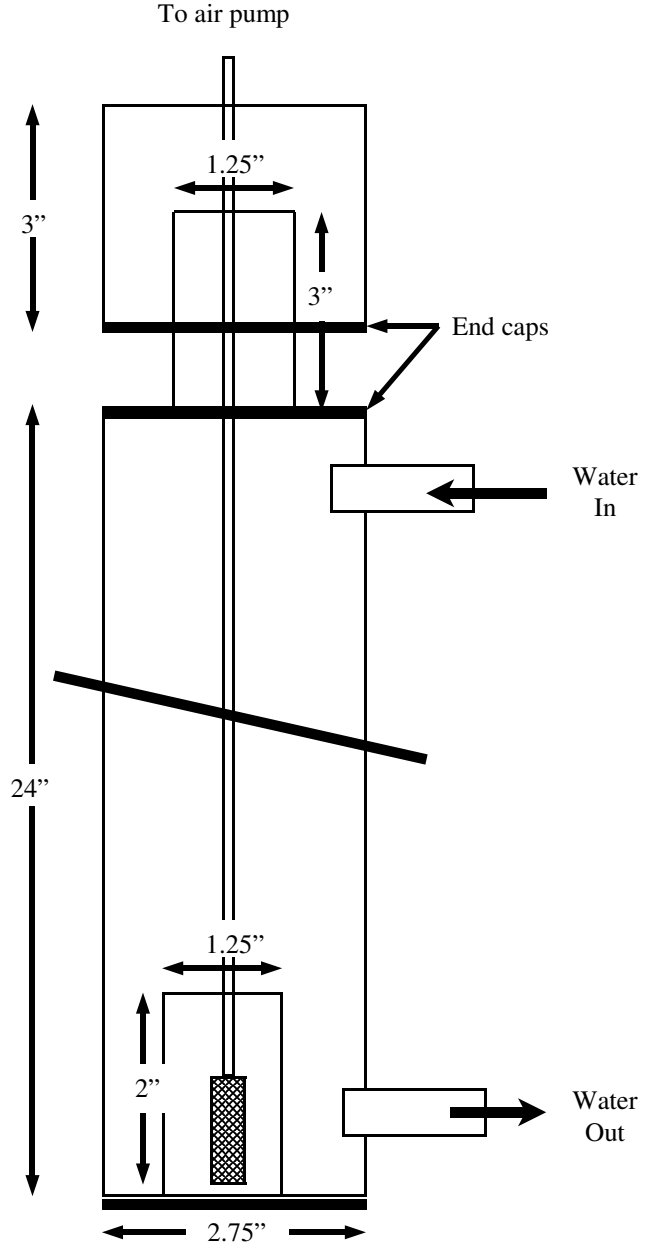

Figure 7.1

e. Test the skimmer to make sure it works. A basswood air diffuser seems to work best because the bubbles it produces are smaller than those a typical airstone produces. A common problem is that the water will drain before the skimmer has a chance to fill up with water. If this is the case, impede the water flow in the outlet tube a little by placing a small amount of filter floss in the opening. The objective is to gauge the water flow so the bottom assembly stays completely full of water without overflowing. If you have a fairly new aquarium or just performed a water change you probably won't extract very much foam into the collection cup. Over time you should notice a fair amount of foam start to collect in the collection cup. Be sure to clean the cup out once a week to make sure water is properly cleaned. Place the skimmer in a position over the sump, so that if a leak does develop, the water will fall harmlessly into the sump. ENJOY!

8. THE WATER CHILLER

Depending on where you live and in what part of the house the aquarium is located, the chiller may or may not be necessary. Normal aquarium temperatures should be between 80 and 82 degrees. If you notice that the water temperature is consistently above this you probably need to incorporate a chiller into your aquarium system.

8.1 TOOLS REQUIRED

- Hand drill and 1/2 inch drill bit (or 5/16 inch if you prefer)
- Screwdriver

8.2 MATERIALS

- 50 to 100 feet of 3/8 inch hard plastic tubing (depending, vinyl isn't as good a choice here).
- (2) PVC fittings (90 degree elbows or straight connects, threaded or slip).
- Aquarium safe Silicone sealant.
- 1/2 inch thin-wall PVC pipe (about 1 foot).
- Bucket that fits inside refrigerator
- Water pump/powerhead strong enough to pull the water through the chiller
- Dorm-sized refrigerator (1 to 1-1/2 cubic feet)

8.3 CONSTRUCTION

a. Begin by drilling two access holes in the top or sides of the refrigerator whichever is most convenient to your situation. Cut 2 pieces of the PVC pipe about 4 inches each. Insert through the holes drilled and seal with the silicone. You may want to reinforce these pipes with a little epoxy prior to sealing them with the silicone. This will keep the cured silicone seal from breaking if you ever want to move the system later on. Arrange the plastic tubing into a coil that will fit inside the bucket. The more coils inside the bucket you have, the more efficient will be your cooling.

b. Glue or thread each end of the tubing onto the 2 access pipes. On the outside, affix two separate hoses to each pipe long enough to reach to the bottom of the sump. The power head will fit on one of these hoses inside the sump. The other hose will serve as the return line (see Figure 8.1).

c. Situate the chiller as close to the sump as possible to reduce ambient heating along the feed lines. Fill the bucket with water and place the coiled tubing into the water taking care to not let the water overflow. The water in the bucket should never come in contact with the water from the aquarium. It provides a more efficient heat transfer system to the water in the coiled tubes.

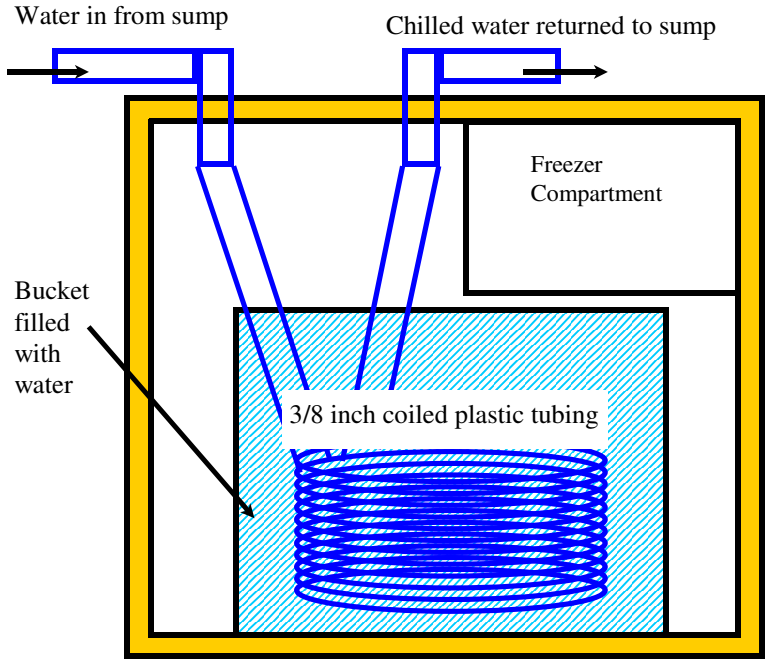

Figure 8.1

d. Plug the refrigerator in and adjust the temperature control until it cools the aquarium water to the desired temperature. This may take a few days of experimentation so it's probably best to experiment on water other than that in your aquarium. There is no need to seal the door. You can store your frozen reef food which we prepared in chapter 5 inside the freezer compartment.

e. Operation is straightforward. Remember to keep the flow fast enough to prevent any water from freezing inside the box. Use opaque tubing to eliminate algae growth from the sump to the unit and back.

9. THE KALKWASSER DOSER

The kalkwasser (German for limewater) doser is an essential part of a marine aquarium containing live coral. Basically, the doser's job is to deliver much needed calcium compounds to the water drop by drop. Too much calcium in the water can cause the fish to get sick, and too little calcium in the water will stunt coral growth. If you have a freshwater aquarium or a saltwater aquarium and don't intend to raise coral, the doser is unnecessary. The operation of the doser is simple. A kalkwasser holding tank is positioned above the sump and allowed to drip kalk into the water that is to be returned to the aquarium. The doser must have a way to vary the drip speed so the proper amount of chemical can be added over time.

9.1 TOOLS REQUIRED

- Scissors
- Waterproof glue

9.2 MATERIALS

- Medical dripper feeder pack (available at a medical supply store see Figure 9.1).
- Airline tubing
- 1 gallon water container (see Figure 9.2)
- Kalkwasser (available at most pet stores)

9.3 CONSTRUCTION

a. Cut the feed bag off of the medical feeder pack. Discard the bag but keep the drip tube. The drip tube should have a variable drip rate thumbwheel knob. Insert the rigid airline tube into the medical drip tube and use waterproof glue or a small hose clamp to make a good seal between the two. Insert the airline tubing into the spigot of the water container. Use a water sealant inside the spigot to preventa leaks. Take care not to block the passageway with the sealant.

b. Fill the container with water and check for leaks. Place the apparatus above the tank or sump into which the kalk will drip.
c. The flow can be adjusted with the thumbwheel knob on the medical dripper. A drop about every ten seconds is usually adequate. The doser will probably need to be cleaned every couple of weeks as the kalk tends to build up inside the rigid airline tubing over time. Clean with warm water only, no chemicals. Monitor the water chemistry closely for the first couple of days making sure everything is normal. Pay close attention to the water general hardness level (GH) and the carbonate hardness (KH). Monitor the calcium level as well. You will probably notice a slight increase the first day but it should level off as the kalk is consumed by the animals in the tank. You may need to adjust the drip rate depending on the size of your tank and the number of animals that require the kalk.

Figure 9.1 Medical feeder bag

Figure 9.2 One gallon plastic water container

10. PH BUFFER

The pH (power of Hydrogen ions) level in your aquarium should be a constant concern for you. There are a wide variety of things that can cause the pH to fluctuate. The occupants in a fish-only tank can tolerate a fairly wide range of pH with no major harm. The occupants of a reef tank, however, rely heavily on a constant pH level in the right range to survive, let alone thrive.

In order to control or adjust pH, we must first understand what pH is. pH is simply a measurement of the acidity/alkalinity of a solution. A pH of 7 is considered to be "neutral," neither acidic nor alkaline. pH levels above 7 are considered to be alkaline or basic. pH levels below 7 are considered to be acidic. The generally accepted pH level in a saltwater aquarium is between 7.6 and 8.4. Reef tanks are a bit more sensitive to pH and should be kept at a higher level around 8.2. The normal trend for pH in a tank is downward, or more acidic. The additions of acids into a tank will lower the pH in the tank water. These acids come from several sources, the primary ones being (1) excess carbon dioxide (CO_2) from respiration caused by lack of sufficient gas exchange, (2) nitric acid from biological filtration (nitrification), and (3) organic acids from metabolic wastes. Respiration and metabolic wastes are a natural part of the ocean as well as your aquarium. The reason that sea water pH does not change is that sea water contains a number of chemicals, such as bicarbonate, calcium, carbonate, borate, and hydroxide which act as natural "buffers" that retard the drop in pH.

When the pH in a tank starts to drop, it is an indication that the buffers are getting worn out. There are a few things that you can do to remedy this increase in acidity. You can use the "quick fix" by adding bicarbonate of soda (baking soda), or use any one of a number of commercial pH buffering products available on the market. Dissolve about one teaspoon of baking soda for each twenty gallons of tank water into a cup of tank water, then slowly pour it into the aquarium or sump. Allow the water

to stabilize for about one hour and then monitor the pH. Repeat if necessary until the pH remains around 8.2. If the water is too basic, add a teaspoon of distilled white vinegar for each 20 gallons of water. Repeat until you achieve the proper pH. Realize that these solutions are a temporary fix and shouldn't be the sole method for pH maintenance.

The best way to stabilize pH is to perform a regular partial water change. This not only refreshes the natural buffers, but also restores the trace minerals in your tank water. Controlling the conditions that cause the pH to decrease is necessary, but they cannot always be removed completely. Removing all uneaten food and fish detritus from the tank on a regular basis will go a long way toward retarding the pH drop. Decorating the tank with shells or corals can cause the pH to rise over time as they slowly dissolve. Take care not to have too many of these types of decorations because they can give you an equally harmful situation if the pH becomes too basic.

11. Implementing Your New Aquarium

I hope you have achieved a sense of satisfaction after having constructed some of the projects in this book. I also hope you saved yourself some money in the process.

The major temptation that comes with this hobby is trying to do things too fast. Before you add any fish to your new tank, set everything up completely and allow all things to function for about a week. You should monitor all water conditions closely and make sure everything is stable before introducing the fish. Start out with relatively inexpensive, hardy fish to "break in" the aquarium. The more expensive a fish is, usually the rarer it is and the more picky it will be about its environment. After a month or two with these starter fish, your aquarium will be ready to take on greater challenges if you so desire. Be careful not to overcrowd the aquarium. You may want to set up a "quarantine" tank to which you add new fish and hold them for a couple of weeks to insure they don't carry communicable diseases. Don't introduce more than a couple of new fish at a time. Make sure there are adequate hiding places in the aquarium so the fish won't suffer too much stress over its new environment and its new tankmates.

The key to successful aquarium keeping is to closely monitor the water chemistry and conditions and know how to fix problems when they arise. An ounce of prevention is worth more than a pound of cure. The most important thing to do in this hobby is to sit back and enjoy the production your fish will put on for you.