Basic Ingredients to a Good Saltwater Aquarium
Written By Daniel Schubert

Personal Background:

By no means do I consider myself an expert, but rather a hobbyist, who has learned through trial and error over a span of many years. I have kept fresh water fish for over 25 years. I finally ventured into reef aquariums about three years ago. I have always wanted to keep saltwater creatures because of the wonderful colours and variety but was very reluctant to start a reef tank because of all the horror stories I had heard about how much more difficult a salt-water set-up is, as compared to fresh water aquarium. At presently I have one 75-gallon reef tank, a 90-gallon freshwater-planted aquarium and a 33-gallon Guppy aquarium.

I'm also a member of the Marine Aquarium Society of Kitchener. Belonging to a club provides one with the opportunity to see fellow hobbyist aquarium set-ups, trade frags (coral fragments) and learn from other people's mistakes.

I have learned that a properly set-up aquarium is relatively easy to maintain. The only down side being the initial investment (cost) of the aquarium, stand and equipment is fairly high. This can be minimized with proper planning. I have found that skimping on the equipment will end up costing double because you end up replacing something eventually anyway. I went through two sets of lighting, and one protein skimmer because I thought I could compromise and save money. In the end I spent more by buying things twice.

A nicely set-up aquarium does provide many hours of enjoyment and is very relaxing to observe the creatures in there natural environment that one's created. I have seen too many people discouraged in this hobby because they bought the wrong equipment, received the wrong advice and end up getting out of the hobby. The first year is the most critical that's when the tanks starts to mature. Un like fresh water tanks the reef tank can take up to two years to fully mature. I myself went through the various cycles including the dreaded hair algae outbreak. But for the last year it has been very stable.

The intent of this booklet is to make one think of all the various options there are and hopefully arm you with enough information to ask the right questions and then make your own sound decision.

Acknowledgment:

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Below are some basic ingredients/considerations in setting-up up a good salt-water aquarium.

But before setting out on your quest, you need to establish some groundwork. You need to consider what type of marine inhabitants you wish to keep.

1. What types of corals you want to keep hard/soft?
2. Do you want to house any other inhabitants such as clams?
3. What types of fish do you want to keep?
4. How many inhabitants do you wish to keep?
5. How large of a tank would you like?
6. What shape of tank do you want?
7. Do you have a physical location for the tank, with sufficient (GFI) power outlets?
8. Is there enough floor joist to support the weight of the aquarium? (General rule, a gallon of waters weighs 10 lbs)
9. Determine what budget you have, and are comfortable with? (Unfortunately this hobby is not cheap)
10. What type of time do you want to invest into this hobby?
    - Daily (feedings, adding additives, water top ups)
    - Weekly (water changes, cleanings)
    - Monthly (cleaning overflow tubes, power heads etc)
11. Determine what monthly running costs you are comfortable with: consider
    - Added electricity costs
    - Additives, Calcium, iodine, salt etc.
    - Bulb replacements (1-1½-2 years depending on lighting selected)
    - Food (corals & fish)

Equipment/Supplies

Additives:
The amount and type of additives added varies greatly with the types and quantity of corals and other inhabitants within your aquarium. Experts and hobbyists can't seem to agree on what is actually required to maintaining good health.

Type	Usage	Comments
Calcium	Calcium is the building block of most corals, coralline algae. The corals absorb the calcium.	Required if keeping hard corals. Alkalinity can also affect the calcium level. The two part system such as ESV B-Ionic, Two Little fishes C-balance or Kent Tech Calcium Buffer Part A, Part B take care of both Alkalinity and Calcium
Iron	Supplemental food for caulerpa, algae	Can cause unwanted algae problems of not properly used.
Iodine	Used for proper growth and health for invertebrates, marine fish and algae.	There is some dispute whether it's actually needed.
Strontium	Used for hard corals, hard shell creatures like snails, clams and hard tube worms.	I have never used
Magnesium	Depleted Magnesium can depress the PH and affect the Calcium level.	I have never used
Trace elements	Replace elements that have precipitated out of the water.	There is some dispute whether it's actually needed.

Table 1 - Additives

Aquarium/Tank: (Required)
Ensure the aquarium is reef ready, avoid at all cost the external overflow boxes they are a pain in the ass. (A big mistake I made). A Reef Ready Aquarium uses internal overflow boxes and a hole at the bottom of the tank. This is a far safer system, easier to maintain and less likely to create a flood.

The main purpose of the overflow box is to skim the surface of the water and removing the thin film present. The thin film reduces air/water exchange and can affect light penetration through the tank.

The external overflow is not as reliable as the internal corner overflows since it requires a U-tube and uses the siphon principal. If air bubbles collect in the U-tube it could lose the siphon and fail. Luckily I have never completely lost the siphon since I use two U-tubes, however I have lost in one or the other. The other problem is that algae and coralline grows inside the tube and if you don't clean them regularly you can lose the siphon.

Acrylic: Pro's; Light, clearer, Con's: scratches easily

Glass: Pro's: harder to scratch, Con's: Heavy, has a greenish tint (unless you get the clear starphire glass).

Considerations:

- The bigger the aquarium, the easier it is to maintain, and the more forgiving it is since the volume (mass) is better able to buffer small mistakes.
- Conversely, the larger the aquariums the more supplies are required, salt, additives, lights etc.
- Keep in mind that water weighs approx. 10 Lbs. per gallon, ensure that the floor joist can handle the weight of the set-up. Have the floor joist run perpendicular to the tank.
- The larger the water surface area the more gasses can exchange between the air/water.
- Keep in mind serviceability, if the tank selected is higher then 24" you will require special tools to reach the bottom (cleaning, picking up fallen corals etc.).
- Type of silicon used to glue the glass tank together; typically clear or black silicone is used. Personnel I prefer the black, it looks cleaner once algae begins to form.
- Type of bracing required especially for a large aquarium, mainly two types are available
    - Euro-bracing: A 2-3" glass brace along the entire 4 sides of the tank. Therefore you have no obstruction for the light, however it does make mounting accessories to the tank more difficult
    - Center brace: A large piece of glass across the middle of the tank, can obstruct the light into the middle of the tank, the salt creep usually covers the glass thus further reducing the light under the brace

Capacity calculation (gallons) = [height (inches) X width (inches) X length (inches)] / 231

Aquarium/Tank Cover: (Not Recommend)
The best is to use no cover at all.

A glass cover will cut down on the light penetrating the tank (the amount of light depends on the glass type).

Extruded acrylic, can yellow over time, and scratches easily when cleaning the salt deposits off.

Acrylic would probably be the better choice if one were absolutely required. It would require occasional replacement as required.

A cover will also keep in excessive heat, thus causing temperature related problems. Additionally the amount of gasses exchanged between the air and water would be greatly reduced.

If the aquarium contains fish that may jump then using an egg crate would be the best solution.

Aquarium/Tank furniture: (Required)
Aquarium furniture comes in a variety of styles from steel tube stands to furniture like cabinets and caps. Personal preference, decor and costs usually determine the selection. Some aquariums are built into a wall; access is gained via a room in the back.

Rule of thumb:

Wooden cabinets:	Stay away from particleboard constructed cabinets, the salt will creep into the particleboard which will balloon and wreck the cabinet.
Steel stands:	Stainless steel is preferable.

Calcium Reactor: (Optional)
Provides a continuous supply of calcium and other trace elements required to make hard corals and coralline algae growth. There are single and dual chamber calcium reactors available. The basic theory of operation is that CO2 is injected into a chamber containing aragonite along with aquarium water. The C02 lowers the PH of the water within the chamber. This along with a circulation pump is used to circulate the water and CO2 through the chamber breaking down the aragonite into calcium and other trace elements. This water is then slowly dripped back into the tank at the same rate as new water is re-entering the chamber. The Calcium Reactor set-up consists of the calcium reactor unit along with:

CO2 Bottle:
Containing the CO2. A typical 10-gallon bottle will last for 8 months and can be re-filled

Regulator:
Used to reduce the pressure of the CO2 gas in the bottle

Needle Valve:
Used to control the CO2 flow into the calcium reactor chamber. It's installed after the regulator.

Aragonite:
Media used within the calcium reactor chamber. Typically it lasts for 8-12 months before it needs to be replaced.

Solenoid Valve:
Attaches in-line with the CO2, used to shut-off the CO@ in the event of a power failure. Otherwise CO2 would fold the reactor during power failure. Some reactors have a shut off valve built into the reactor.

Water Pump:
Some reactors require an additional water pump (Usually a small power head) to feed water into the unit.

Canister filter: (Not Recommended)
Filter used mainly in fresh water aquariums. It can contain various media such as foam, activated charcoal, peat moss. Not recommended for reef tanks

Carbon:
Used occasionally as required to remove odour and colour from the water. Carbon can be placed inside a filter bag and placed within the sump.

Cleaning Supplies:

Algae Scrapers: (Required)
Used to remove unwanted coralline algae from the aquarium. Note: there are typically two different types of scrapers, one intended for glass tanks, which have metal blades another one for acrylic tanks, which have plastic blades.

Turkey Baster: (Required)
Used to blow fine sediment off the rocks

Algae magnets: (Required)
Used to clean unwanted algae from the tank. Be careful when cleaning the glass at the bottom of the tank near the substrate; ensure that you do not get any sand particles caught between the glass and the magnet.

Tongs: (Optional)
Used to feed aggressive fish, move rocks and corals.

Gloves: (Optional)
Used to cover your hands and arms to protect you from getting bitten from creatures that may be on the live rocks. Personally I have never been stung by anything yet, but have known people who have. Can also protect the ecosystem from human contamination such as soaps etc. that may be present on your arms.

Closed Loop System:
One of the various methods of creating water flow within the aquarium. Can be used in conjunction with power heads or instead of power heads. This type of method usually requires extra holes to be drill within the tank.

Deep Sand Bed (DSB): (Optional)
Consider adding a deep sand bed to either your refugium or main tank. This is at least 4” of very fine sand such as **Carib Sea Aragamax Oolitic,** or Home Depot Southdown tropical play sand. The DSB will create a de-nitrification bed, which will help control the Nitrates and Nitrites. Some individuals like to layer the sand starting from a fine sand as mentioned above to coarser sand above.

Density:
Is the weight divided by the amount of space it occupies, usually expressed in kg per cubic meter. Natural seawater weighs 1025 kg per cubic meter

Electronic salinity meter:
Use the principal of electrical conductivity, a measurement the conductance, the amount of electrical current that can be conducted to determine the amount of dissolved salts with the water

Pin Point Salinity Meter

Fluidised Sand Filters: (Not Recommended)
External filter that passes water through a fine layer of sand. Not recommended for reef tanks

Generator: (Recommend)
A back up generator to supply power to the pumps, skimmer and heater/chiller in case of power failure should be considered, during the August blackout along the eastern sea board, Ontario included, considerable hobbyist lost a lot of livestock due to the power outage. The overall investment may be small considering the amount of money one has invested into the livestock; additionally we should due what ever we can to try to keep these animals alive. The size of generator required is very dependent on the size of the tank. Lights can be easily left off for a couple of day's

GFI Ground Fault Interrupt: (Recommend)
Any electrical outlet used around water should be protected with a GFI outlet. This will prevent both the marine inhabitants and the person servicing the tank from electrical shock in the event of equipment failure. Submersed power heads, heaters can be damaged, cracked causing the potential for shock.

Ground Probe: (Recommend)
A titanium probe used to ground the aquarium water to earth ground on your electrical outlet. This will remove any stray voltages induced by your florescent lights, power heads etc.

Hang on Power filter: (Not Recommended)
Filter used mainly in freshwater tanks. It can contain various media such as foam, activated charcoal and other media. Can be used for creating surface agitation if run empty or just with activated carbon. Overall not recommended for reef tanks.

Heaters/Chillers: (Heater – Required, Chillier - Optional)
The marine environment is one of the most stable environments on earth. The water chemistry and temperature stays very consistent. Thus the inhabitants have not developed any immune system to compensate for large temperature variations.

Electronic controlled heaters are required to maintain the aquarium at steady 79-82 degrees Fahrenheit. The marine inhabitants cannot tolerate large temperature fluctuations.

Chillers may be required if the tank temperature rises above the desired levels. Fans may be used to blow air over the water causing evaporation, which will aid in cooling the water.

Hydrometer: (Required)
Measures the specific gravity (density) of the salt water thus indicating the amount of salt contained with the water.

Hydrometers

Lighting: (Required)
Probably one of the most controversial subjects in the aquarium hobby. Type of lighting used depends on numerous factors

- Type of creatures to be housed
- The depth of your tank.
- Your own colour preferences. Some bulbs provide more of a bluish tint, others yellow, some are whiter.
- Growth rate of corals

A Kelvin degree indicates the colour of the light. When purchasing bulbs they must be at least 6,500K, below this usually cause algae problems. 6.5K is consider equivalent to natural sunlight at noon

Common colour temperatures are:
6,500 (6.5K) – slightly yellowish
10,000 (10K) – whitish – blue
12,000 (12K) – bluish
20,000 (20K radium's) – blue

CRI – Colour rendering index, a measure comparing artificial light to natural sunlight. The higher the number the closer it resembles daylight.

Rule of thumb:

Metal Halide: Hard corals, clams and deep tanks (> 24 inches). Metal Halide also provides a shimmering effect. Standard bulb wattage is 175, 250 and 400 Watts

HQI Double ended Metal Halide. I have not had the opportunity to study this type of lighting so I will not comment at this time. Standard bulb wattage is 150, 250 Watts

VHO: Very High Output (usually 1200 ma) fluorescent bulbs. Soft coral such as leathers or polyps, shallow tanks. Table 1 below summarizes typical bulb length/wattage for Ultraviolet Resources International (URI) aquarium bulbs.

Length of bulb	Wattage
18”	30 Watts
24”	75 Watts
36”	95 Watts
48”	110 Watts
46.5”	110 Watts
60”	140 Watts
72”	160 Watts
Table 2 – URI VHO bulbs information	

HO High Output (usually 800 ma). Not a common bulb.

PC Power Compacts, Standard bulb wattage is 55, 96 Watts

NO: Normal Output (usually 400 milliamps) fish only tanks

Length of bulb	Wattage
24”	20 Watts
36”	30 Watts
48”	40 Watts
Table 3 –NO bulbs information	

Note: NO bulbs come in T5, T8 and T12 bulb configurations, T- standing for 1/8” diameter. As an example a T8 bulb has a 1” diameter. When purchasing T5, T8 and T12 bulbs ensure that your ballast is rated for your particular bulb type. Regular T8 ballasts cannot light a T12 bulbs. There are only a very few ballasts like the ICECAP 660 or 430 that can light various bulb configuration

Ballasts: Ballast for metal halide, HQI and fluorescent tubes are usually found in two forms, electronic and transformer (capacitor for Metal Halide/HQI) type. The electronic ballast usually provides better efficiency and longer bulb life then the transformer counter part. However the initial cost is usually much greater.

Live rock: (Required)
Live rock is used as the main filter media; it contains various micro-organisms and other small creatures that are used to control the environment. Do not over pack the rocks; provide various gaps, and holes to allow water movement. Fish will also appreciate these hiding spots. The only filtration required is the live rock and a protein skimmer.

Medication: (Avoid)
Avoid using medication in a reef tank, if it's absolutely required ensure that it is reef safe and contains no copper. Copper will kill invertebrates, corals and all the little copepods, worms that make the tank healthy. Copper will leach into your rock killing off all the beneficial bacteria and making your rock basically worthless.

Patience:
Key factor to a successful reef tank. Remember add things slowly. Let the environment slowly adjust to anything that you may want to add

Plumbing: (Required)
Use only PVC or CPVC fittings when plumbing in a sump, refugium or a closed-loop system. ABS pipe is not suitable for Aquarium use, you run the risk of having materials leach into the water. ABS piping is used mainly for waste. CPVC and PVC are used to carry water.

Power Heads: (Required)
Used to create water movement within the aquarium. Having high water movement is critical in maintaining a reef tank. It keeps detritus (waste) suspended in the water allowing the filtration to remove it more easily.
Example:
- Maxijet series MJ400, MJ600, MJ900, MJ12000 (most common power heads used)
- Hagen series AquaClear 201, 301, 402, 802
- Tunze series Turbelle 7300/2, 7400/2, 600/2, 1000/2

Protein Skimmer: (Required)
Don't skimp on a skimmer. Buy a proper skimmer the first time. Note: most skimmers are over-rated by the manufacturer. Buy one that is twice the size you need just to be safe. Skimmers remove organic waste before they decompose by generating fine bubbles, which attract the waste and then carry it into a chamber for collection. The main characteristics of a good skimmer are:

- Produces very fine bubbles
- Chamber is completely covered in bubbles
- Good bubble contact time, usually a larger chamber is better

There are various methods.

Venturi:

Uses a venturi to suck in the air. A large pump is required
Examples: Klaes Junior, Precision Marine (PM) CV426, CV626, Kent Nautilus, Red Sea Berlin XL

Counter Current:

Typically the cheapest type of skimmer available to the hobbyist. They use a wooden stone and air pump to generate the bubbles. A small pump is used to re-circulate the water. They can be very efficient if properly set-up and sized for the tank. Down side is that the wooden stone needs to replaced every 3-4 weeks.
Examples: Saline Solutions – all, Marine Technical Concepts (MTC) TM-3000

Beckett Injected:

Uses a Beckett head to create the bubbles. A large pump is required to force the water through the Beckett.
Examples: MTC HSA 250, HSA1000, PM bullet series, Aerofoamers.

Downdraft:

Uses a combination of Bio-balls and venturi in a large pipe. The water is forced down the pipe containing bio-balls. The bio balls break up the air/water creating the bubbles.
Example: ETSS Reef Devil, ETSS 800

Venturi/pump:

Klaes, Euroreef, Deltec, Aqua-medic and Red Sea also make skimmers with custom impellers. The air is sucked in similar to that of a venturi type skimmer however they have a needle type impeller, or impellers that have holes drilled into the blades to create the bubbles.

Pumps: (Required)
Used to carry water from sump/refugium to main tank. Pumps are available in basically two forms. Submersible pumps can be placed within the tank. Down side being that they may introduce heat into the water.

Refractometer: (Recommended)
A device used to measure the salinity of the salt water. It uses the principle of light refraction to determine the amount of dissolved salt contain within the water.

Refactometer

Refugium: (Recommended)
A separate area within the sump or stand alone tank which allows algae, copepods, shrimp, worms and various other creatures to grow without being disturbed by fish and crabs. This will also provide live food source to the main tank and provide additional de-nitrification. The main types of refugium.

- Hang-on external type like the **CPR** or **Ecosystems** which provide a little pump to bring aquarium water into the refugium and then use gravity to re-circulate the excess water (along with some critters) back into the tank.
- An area separated in your sump that performs the same function as described above
- A complete aquarium feed by tank water similar in function to the hang-on external.

R0/DI Filter: (Required)
Reverse Osmosis / (Optional De-ionized) water filtration system is a must in keeping either a Reef or Fish only set-up. RO and R0/DI removes impurities found in ordinary city/well water.

Failure to do so will result in algae problems, and health related issues of the aquarium inhabitants

Salinity:
Salinity is the measure of dissolved salts in water express usually as PPM (Parts Per Million) or PPT (Part Per Thousand). Natural seawater has a range of 33,000 PPM to 37,000 PPM or about 3.3% 3.7% dissolved salt. Fresh water usually has less then 1000 PPM. Factor affecting Salinity of natural seawater is depth (pressure), temperature and location. Measurement of salinity in Sea water can be accomplished by various methods

- Evaporate the water away to leave dissolved solids
- Titrate for each of the major ions then add them up
- Hydrometers
- Measure the refraction of light (Refractometers)
- Measure the conductivity of the water and then convert to salinity (electronic measuring device)

Sea Salt: (Required)
Used to create seawater.

Sump: (Recommended)
I'd get the biggest sump that you can possible house. The sump will most likely house your skimmer, heater and ground probe. I'd also consider sectioning a piece to add a refugium. This will help your excessive nutrient exports and help control any algae problems in the main tank.

Sump design considerations:

- Has enough surplus volume to allow the water to flow back from the main tank in case of a power failure.
- Has sufficient number of baffles to eliminate micro bubbles being pumped back into the main tank.
- Provides ample space for maintenance of your skimmer (for in sump skimmers).
- Provides ample space to add a refugium

TDS Meter: (Optional)
Measures Total Dissolved Solids in the water. Measures amounts of minerals in the water and is often used to measure the effectiveness of your water purification system (RO/DI system). Hi TDS readings on your RO unit are an indication that the RO Membrane needs to be replaced.

Test Kits:
As a minimum you will require to test Ammonia, Nitrate, Nitrites, PH.
Calcium and Alkalinity are required when keeping hard corals or for coralline algae growth.

Test kits do have a shelf life especially once opened, if you start getting un-normally readings verify the reading with a local fish shop or purchase an additionally kit. I personally have had problems with the Carbonate hardness test kit going bad.

Type	Usage	Comments
Ammonia (NH_3)	Test for Ammonia in the water, fish waste creates ammonia. Ideally readings should be zero, before adding any livestock	Required
Nitrate (NO_3)	Test for Nitrate in the water, Ammonia is converted to Nitrate by Nitrosomonas bacteria. Ideally readings should be zero, before adding any livestock	Required
Nitrite (NO_2)	Test for Nitrite in the water, Nitrate is converted to Nitrite by Nitrobacter bacteria. Ideally readings should be zero, before adding any livestock	Required
PH	Tests the PH of the water, ideally it should be 8.2 – 8.4	Required
Calcium (Ca)	Tests the Calcium in the water, ideally it should be greater then 400	Required – if keeping hard corals
Carbonate Hardness (KH)	Tests the Alkalinity of the water, ideally it should be between 8 and 12 dkh	Required – if keeping hard corals
Silica (Si)	Test the Silica in the water	Not required, not a common test kit
Phosphate (PO_4)	Phosphates usually cause algae related problems	Only if Algae problems persists
Iodine (I_2)	Test the Iodine in the water	Not required, not a common test kit
Magnesium (Mg)	Test the magnesium in the water, maybe required if you are having trouble maintaining the alkalinity and calcium levels required	Not required, not a common test kit
Copper (Cu)	Tests for copper in the water, a reef tank should not contain any measurable amount of copper. Corals and invertebrates will die if copper is present. **Note:** Copper is used in many fish medication.	Any used rock that is purchase from an unknown source should be tested for copper before adding into a tank
Strontium (Sr)	Test the magnesium in the water	Not required, not a common test kit
Oxygen (O_2)	Test the amount of oxygen in the water	Not required, not a common test kit
Boron (B)	Test the boron in the water	Not required, not a common test kit
Activated Carbon (C)	Test the carbon in the water	Not required, not a common test kit
Iron (Si)	Test the Iron in the water	Not required, not a common test kit

Table 4 – Test Kits

Thermometer: (Required)
Used to measure the temperature within the aquarium. Various types of thermometers exist. They range from external stick-on type to digital read-out. Some have High/Low temperature alert to signal when the temperature is outside a specific temperature range.

Trickle filter: (Not Recommended)
Similar to a sump but uses bio-balls for de-nitrification. This is old technology and no longer used by many reefers

Wave maker: (Optional)
Used in conjunction with power heads to create a more natural environment by creating alternate water current within the aquarium. This helps reduce dead spots (stagnant water) areas, which can create problems within the tank. Additionally it stimulates live coral by providing a more realistic environment.

Ultra-Violet Sterilizers: (Not recommended)
Uses radiation to kill off microscopic organisms. However it kills all microscopic organisms, good and bad.

Animal Considerations:

Corals:
Lighting level and water flow is very important when keeping corals. Research the light and flow requirements before purchasing any corals. Be aware that some fish will eat polyps so ensure that all fish purchased are reef friendly. Additionally some corals do not require high lighting, and some need to be feed daily such as sun corals.

Clams:
Lighting level is very important when keeping clams. Research the light and flow requirements before purchasing any clams. Be aware that some fish and snails will eat clams so again fish selection becomes more limited when clams are introduced.

Fish:
Marine fish are very territorial; you should never over stock a tank. Also be aware that some species need to be kept singularly or in large groups. Do research on housing requirements and food requirements before purchasing any fish.

Set-up:

Step 1: Education.

Learn as much as you can about the hobby, requirements and equipment. The Internet has a wealth of good/bad information.

Join a local Marine Aquarium club such as MASK (Marine Aquarium Society of Kitchener) or MAST (Marine Aquarium Society of Toronto). Look at other hobbyist aquarium set-ups, ask a lot of questions and learn from their mistakes. Most hobbyists would be happy to share their experiences. Unfortunately this hobby contains allot of misinformation, additionally there is no one right answer to which piece of equipment or method is the best. You will have to conclude which type of set-up will work for you.

Purchase a couple of modern books. Libraries may be another source of information however, I have found that most library books are very dated and actually mislead me with false information; the hobby has advanced since some of those books were published.

Visit a couple of the Local Fish Stores (LFS). Browse around a see what kind of equipment they carry. Test their knowledge against what you have read. Ask questions. Be mindful that some LFS may try to sell you stuff that you really don't need. At this stage you are in the gathering information stage so don't feel pressured into buying anything get. Look at the livestock and try to determine what type of fish/clams/shrimp/crabs/snails/corals etc. you may want to keep. The hardest part is selecting the inhabitants that will get along with each other. You may have to sacrifice one type of fish you desire in order to keep clams, or vice versa. Make a small list of the inhabitants at the LFS and then research them some more. Check for.

- Feeding requirements
- Lighting requirements
- Tank size requirements
- Water flow requirements
- Compatibility with one another

Step 2: Planning:

Once you have a rough idea of the inhabitants you wish to keep and their requirements, start to select the equipment required to support them and keep them healthy. After all, these are live animals and should be treated with the best we can offer them. If we can't satisfy their needs it would be cruel to purchase these animals.

Select appropriate tank, lighting skimmer etc. and create a shopping list. When selecting equipment consider

- Quality
- Serviceability, you will need to maintain this stuff
- Warranties
- Parts availability
- Company reputation and track record

After the list is complete you can start costing the equipment and ensure that it's within your budget constraints. Ensure that any equipment substitutions made because of pricing, availability etc. will not adversely affect your original goal. Ensure that your choices are at least equal to your needs. Some suppliers may provide you with a discount if multiple items are purchased from the same source. Additionally if you do belong to a club or are a member of an Internet bulletin board you maybe able to save yourself some money by getting some good quality used equipment. Which ever you decide make sure it is compatible with your plan. Do not buy a protein skimmer that is under-rated because you got a good deal. In the end you will replace it anyway.

Stage your purchases, as required this can help with the budget. Like lighting will not be required until the system has cycled, or almost cycled. You may want to purchase the lighting at that point or at least the bulbs.

Step 3: Tank set-up:

Install the tank, refugium and sump depending on system design. Use PVC and/or CPVC pipes and fittings for all plumbing supplies. Keep in mind serviceability. Gate and/or ball valves can be used to shut-off the water outlets and when used in conjunction with quick disconnects will allow disassembly of various equipment for easy maintenance. Remember the majority of components need to disassembled periodically to remove build up of calcium, algae and other animals/minerals that will be sucked into pumps, skimmers etc. Impellers of pumps need to be periodically cleaned to ensure long life and proper water flow.

Installation of electrical power powers and light ballasts can all be neatly arranged for easy access and serviceability. There is nothing worse than plugs that are hidden behind tanks, sumps etc.

Step 4: Leak check:

You may want to fill the system, tank, sump, refugium, skimmer etc. with plain tap water and allow everything to run for an extended period of time. This will give you the opportunity to check for leaks and make sure everything is working as expected. Additionally this will help remove any contaminates that may have been on the glass or acrylic. Let it run for 2-3 days just to make sure all is well. It's a lot cheaper to clean-up plain water then it is with RO water with salt added.

Once you are satisfied with the systems performance you can drain all the plain tap water and rinse everything with a little RO water.

Now you are ready to add the substrate in the tank and refugium (If you decide to go with a refugium). Some recommend that the substrate should be washed and others recommend adding as is, stating that washing removes some of the desired fine particles. I have tried both ways with no ill effect.

Slowly add your RO or RO/DI water and fill up the system. If you pre-washed your substrate there may be less cloudiness than if it was added unwashed. You may have to remove some of the scum from the top of the water using margarine containers. Once the desired water levels have been reached in the system turn on the pumps and start the skimmer.

Step 5: Water Cycling:

Once the water has been added, and no leaks persist, then you are ready to start adding the salt. The salt could be premixed in food grade containers however depending on tank size this may not be possible or practical. Additionally, adding salt to the water in the tank allows for one more leak check before adding the expensive sea salt. The salt can be added directly to the water, since there are no animals present yet. Add about 75% of the recommend salt and allow the salt to dissolve for a couple of days. Then slowly add salt as required until the desired specific gravity is reached. Once the specific gravity is stable for a couple of days you can start adding the live rock.

The rock should be slowly added especially if it's un-cured. This allows the protein skimmer to remove any die-off thus keeping the Ammonia, nitrates and nitrites (A-N-N) to a minimum. This allows more of the critters on the rock to survive. When aquascaping ensure that you leave plenty of room to allow water flow between and around the rocks. It is not desirable to have detritus trapped underneath/in-between the rocks

The rocks should be added over several weeks. During this process you will want to start monitoring your A-N-N. Once the rocks are in place and the A-N-N readings are all zero for at least two weeks your system has completed the cycle. All the rock die-off will have started the nitrogen cycle. The cycle can last up to 6 weeks before the readings are acceptable.

Step 6: Adding livestock:

Once the system has completed the cycle you can either allow the critters to grow some more before adding the livestock or slowly start adding the livestock. You need to add the less territorial fish first. The rate on which fish can be added depends on volume of water in your system. Additionally every time something is changed, the system needs to rebalance itself. The extra bio-load will require additional bacteria in the system to break down its waste product. Thus it's a good idea to add things very slowly over time. Keep at least a month between additions

When adding livestock ensure that you slowly drip the animals. This can be accomplished by placing the animals in a container on the floor beside the tank. Using standard airline tubing, tie a knot in one end to slow the water flow. This will allow the water to slowly drip into the container holding the animal. After ½ hour or so you can remove the animal and place it within the tank. Note: Do not include the water from the Local Fish Store. This may contain copper or other medication that could be harmful to the inhabitants in your established tank. The purpose of the drip method is to slow acclimatize the animal to your water conditions. Not allow salt-water tanks are kept at the same parameters.

Approx. cost of a reef set-up could vary. It depends allot on the type of stand that you'd want. Lighting would also play a major factor but as a Rough order of Magnitude (ROM).

Approximate cost of set-up (100 gallon Tank):
Tank - $550.00 +/- $100 (with hole and overflow)
Stand - $200.00 - $2,000.00 or more, if custom
Cap - $200.00 - $1000.00 or more, if custom
Power Heads (at least 3) - $150.00 (Maxi jets)
Wave maker - $130.00
Heaters - $180 (suggest using 2 smaller then one large)
Skimmer - $400.00 for midrange

Pump for skimmer $150.00
Return pump for tank - $300.00
Plumbing parts - $200.00 (pipe, shut-off valves etc)
Sump/Refugium - $300.00 - $600.00 depending on size
Lights - $750.00 VHO (with end caps, bulbs)
Lights - $1400.00 Metal Halide/VHO (Bulbs and ballasts)
Salt - $80 bucket
Test Kits - $60.00
RO/DI Unit - $300.00 - $500.00 (depending on gallons per day, number of stages etc)
Thermometer - $6.00 - $60.00
Live Rock - $6.50-$8.00 per lbs (You'll need at least 80 lbs, don't over stuff with rock)
Sand - $50.00 per 30lb bag (Need at least 3 bags unless you want a dsb then you'll need more)
+ Corals
+ Fish

Maintenance:

Daily

- Feed the tank inhabitants. Some people feed more frequently then others. It depends on the type of animals housed and amount of food available on the live rock. Over feeding can cause algae problems.
- Inspect inhabitants for any signs of disease, ensure corals are opening properly. Corals usually provide the first signs that there is something wrong.
- Check skimmer cup and empty as required
- Check for signs of water leakage
- Add additives as required
- Add new RO water to replace water evaporated unless an auto top off system is used

Weekly

- Add additives as required
- Clean skimmer cup as required
- Perform a 5-10% water change. Prepare the salt water at least one day in advance in a food grade bucket/container. Only use R0 or RO/DI water. Ensure the container used does not leach out any contaminates that will harm the tank. Use a small power head to mix the salt
- Clean glass as required using Algae magnet and/or scraper
- Test water quality parameters and ensure everything is with acceptable limits

Monthly

- Inspect overflow tubes to ensure proper water flow, clean as required
- Inspect all power heads
- Clean bulb as required

Quarterly

- Clean impellers on power heads as required
- Disassemble skimmer and do a thorough cleaning

Yearly

- Bulb replacements (depending on type of lighting selected), Stagger the schedule for replacing the bulb to minimize the impact on the tank
- If Calcium Reactor is used
    - Replace media
    - Re-fill CO2 bottle
- Clean Impeller on main return pump