greenscapes
LANDSCAPE DESIGN MAINTENANCE

CERTIFIED Aquascape™ CONTRACTOR

A Closer Look

The Ecology of Your Pond
Ask any pond owner how long they spend letting time slip away just watching their waterfalls, streams, and Koi. I know I could spend an entire day watching ours! While no one needs a biology degree to own or maintain a water garden, understanding the inner workings of your pond can open your eyes to a whole new world. If you were to take a drop of water from your pond what do you see? You're probably thinking, "I see a drop of water Bob are you losing it?" Well, the truth is there is an entire world inside that drop of water and it, along with the rest of the components that make up the Aquascape Designs ecosystem, are working along with Mother Nature for you! Now don't go out and register for microbiology just yet. In our new newsletter section, A Closer Look, each month I will walk you through some of the most interesting and incredible processes that are going on inside your pond right now!

A Guide to understanding Algae
I know you won't want to hear it, but step one is, Be Patient! If your system is new, understand that it takes between two and six weeks for the bacteria to colonize and actually begin to do their job. Creating a balanced ecosystem doesn't happen overnight. Like fine wine, ponds mature with age, so don't be surprised or concerned if a new pond begins to grow some algae. Once the plants, fish, and bacteria are established, the algae will decrease.

Yearly Cycles
Most ponds undergo an algae cycle every year. In colder climates, both plants and bacteria will go "dormant" due to a lack of available oxygen and cold water. This creates less competition for nutrients and advantageous conditions for algae growth. The pond may turn green or become full of string algae in winter. Once the temperatures warm up, the plants and bacteria will begin to establish themselves once again.

Other Causes for Algae - Was your system designed properly?
1. Overstocking/overfeeding - too many fish. Stock at 1" of fish per 20 gallons of water.
2. Under circulating - is your pump too small?
3. Underfiltering – are the pump and filters sized correctly for your volume?
4. Immature pond - as stated above
5. Runoff and/or rain - closed systems do not handle unintended input

What Works and What Doesn't

Myths

- Shade - Algae needs very little sunlight to grow. Contrary to popular belief providing shade will help stabilize temperature, but has little to no effect on algae short of completely covering your pond. Algae do love warm water though. As mentioned, shade will lower and stabilize your temperature.

- Flocculants - Often misused, flocculants will help clear water from organic debris including dead algae. It has very little effect on living cells. As some of Norm Mocks research implies the consumption of dead algae cells may contribute to the killing of living cells by the release of an antibiotic. This being the case removing the dead cells may actually inhibit a natural control. There is a fine balance there however as the dead cells also becomes a food source for a recurrent bloom.

- Major water changes - This obviously removes algae, but does nothing to control growth of the remaining algae and it adds nutrients.

- Nitrifying bacteria eat the algae - Nitrifying bacteria are chemoautotrophic bacteria, they use only inorganic sources. Nitrosomas convert ammonia to nitrite, Nitrobacter convert the Nitrite to Nitrate.

- Algaecide - Most are copper based. Koi and copper are not friends. Quick kills of Algae blooms also use up too much oxygen

Facts

While there is no "snake oil" or magical fix, Aquascapes has you covered:

- SAB Extreme - String Algae buster is for STRING ALGAE (Filamentous). Use this for prevention. SAB locks up" calcium. Without calcium string algae breaks up. Best control - Use your hands and get in there and take it out! Your fish will be happy to see you.

- EcoBlast - String algae control. Works by direct contact with the algae. EcoBlast is not temperature sensitive.

- EcoBarley- Decomposition of barley releases peroxides that break down the cell walls of algae. Again, helps more with prevention - not bloom control. Will take 4-6 weeks.

- Aquaclearer Extreme - Heterotrophs explained above and enzymes aiding in organic decomposition. Use Aquaclearer Extreme Liquid after temperatures stabilize above 55 degree your spring clean out is finished. This will help seed your BioFalls quickly. New Extreme Dry formula also contains activated Barley.

- Bioballs - Lava Rock becomes clogged in one year. Replace with bioballs your second year. Bioballs add more surface are for bacterial colonization and do not clog like lava rock which will help avoid channeling.

Best practices are physical and require your involvement:

- **Under or properly stock – 1” per 20 gallons**
- **Over Circulate - turn over water volume at least every 1.5 hours**
- **Over filter - be sure your biomedia is "fit" to the biofall. The water must past through it, not around it.**
- **Time - relax it isn't a swimming pool. Let it balance**
- **Proper cleaning and maintenance**
  - **10% water changes regularly**
  - **Fall / Spring Cleaning**
  - **50-60% plant coverage**
  - **cleaning skimmer mats at least biweekly**
  - **hand removal of string algae clumps and EcoBlast treatments**
- **Testing Water Quality**
  - **Ammonia 0ppm**
  - **Nitrates under 80ppm**
  - **Nitrites 0ppm**
  - **Chlorine reading of 0ppm**
  - **KH over 80ppm**
  - **pH stable between 7 and 9**

The Nitrogen Cycle – Is that what Lance Armstrong rides?
Koi and decaying organic materials are continually producing ammonia. By converting the produced ammonia (NH_3) to nitrite (NO_2) then to nitrate (NO_3), we can further break the nitrate down to nitrogen gas (N_2) or nitrous oxide (N_2O) and this can then be gassed off thus completing the nitrogen cycle. The first element produced by carp/Koi is ammonia, Koi cannot be subject to Ammonia in anything other than very low concentrations, over time aerobic bacteria are naturally formed in the filter called Nitrosomas spp. and Nitrobacter spp, These two specific bacteria need only a source of energy, oxygen, and a substrate the rest mother nature will take care of.

Nitrosomas, classed as chemoautotrophic bacteria, are responsible for the conversion of ammonia (NH_3 and NH_4+) to Nitrite (NO_2). Nitrosomas utilize ammonia as a food source, oxidizing the ammonia to form Nitrite, (NO_2). Nitrite in itself is nearly as toxic as ammonia in its newly formed state, but a second colony of bacteria form, again quite naturally, called Nitrobacter spp, they convert the Nitrite to Nitrate (NO_3), which is about 1 hundred times less toxic to fish than either ammonia or nitrite.

De-nitrification can take place by another set of bacteria called heterotrophic bacteria. These bacteria require complex organic compounds of nitrogen and carbon for metabolic synthesis, these bacteria can be aerobic or anaerobic, (function in the absence of oxygen) and are capable of conversion of Nitrate NO_3 to nitrogen gas (N_2) or nitrous oxide (N_2O) thus keeping nitrate levels down to a minimum. These bacteria are required in sufficient numbers to make a difference to the background levels of nitrate.

There are also a select number of anaerobic bacteria that will use the oxygen and nitrate to reverse the nitrogen cycle. By removing one oxygen atom at a time it can convert nitrate NO_3 back to Nitrite NO_2, then back to ammonia NH_3/NH_4 This is accomplished by anaerobic bacteria usually found in the sludge build up in the bottom of a dirty pond or filter, as the sludge builds, it deprives the bacteria of oxygen and becomes one of the main reasons for a filter crash. This is why a correct install has less than 2 " of gravel on the pond floor. The aggregate provides surface area for colonization. Too much creates unfavorable conditions.

Competition for Nutrients - Plants and Ammonia

We know that algae will proliferate when ammonia levels are higher. One of the main foods for algae, both single cell and filamentous is also nitrogen (N). Plants readily take up and use two forms of N: ammonium (NH_4+) and nitrate (NO_3-). Other forms of nitrogen must be converted to one of these compounds by natural or artificial means before plants can utilize them directly as a source of nitrogen for plant growth.

Why is ammonia is easier to break down than nitrites or nitrates?

The ammonium molecule (NH_4+) carries a positive electrical charge and is attracted to the clay and/or organic matter around the roots, which carry negative charges. I'll call the organic matter around the roots "soil" just for simplification. Once attached to the "soil" matrix, ammonium becomes part of the cation (pronounced "kat-i-on") exchange process whereby plants exchange a hydrogen ion (H+) for one of the positively charged molecules in the "soil". As long as the temp and the pH are low enough the second that ammonia hits the water it picks up the extra H+, hydrogen ion and becomes ammonium and is useable by plants and algae. NO3- must be reduced to ammonium before it can be incorporated into proteins anyhow. The conversion is catalyzed by enzymes collectively called the nitrate reducatase system. They produce enzymes like glutamine which are then transported throughout the plant. In essence they produce the N containing compounds that can be used in protein synthesis. As we already said since nitrosomas are changing NH_4+ to NO_3- (nitrification) it is Nitrate that is more abundant, but not preferred. Again since it is not positively charged it is not "bound". (This is why we have to fertilize lilies since it is not bound it is "leached" from lily pockets). This reductase process is inducible. Inducible enzymes are common in bacteria but very uncommon in plants. Then of course we get the De-nitrification by the heterotrophs converting NO_3 to nitrogen gas (N_2) or nitrous oxide (N_2O).

Why do we add bacteria?

Decomposing bacteria and the bottled stuff we add are all heterotrophic bacteria. These bacteria use organic, nitrogenous material like plants, debris and dead fish as their source of food and carbon source. These bacteria can be either anaerobic or aerobic and are capable of producing spores. That's why they can be bottled or dried. As we have said, these organisms conduct a process called aerobic bacterial decomposition but it is more commonly known as decaying or rotting. They consume dead organic matter. Green water is caused by an excessively large number of tiny organisms in the water called phytoplankton. Algae have specific requirements for growth just as any other plant. Competition and removal of requirement sources limit its growth.

Interesting Recent Studies

When algae cells die, the cell wall bursts from osmotic pressure. Newly exposed cytoplasm from within the cell sticks anything that it comes in contact with first. A natural

gathering point for adherence is on your biofilter media. The oxygen rich environment, cytoplasm and cell wall for food create a perfect dining environment for heterotrophic bacteria. While cytoplasm appears to be the first course, they soon move to consuming the cell walls. New studies indicate a waste product of the decomposition process of the cell walls is an antibiotic that is toxic to living algae. The presence of the antibiotic causes more algae cells to die off, thus creating more food to support a larger bacterial colony. The cycle continues to feed off itself until equilibrium is reached via a limiting factor such as limited algae left to consume or limited space to for colony growth.

Potential Hydrogen (pH)

The typical pond system has a pH reading between 6 and 9. A neutral pH is found at 7 (hydrogen and hydroxyl ions balanced). You should be as close to neutral as possible. A high pH is not much to worry about unless it rises above 9 at which time ammonia becomes more toxic to the fish. A low pH should be corrected immediately or acidosis can occur. Unless you are breeding fish, keeping prize fish or a heavy fish load, as a pond hobbyist, it is very uncommon to have to worry about pH. A good percentage of the pond troubleshooting calls we get are system crashes resulting from the improper and unnecessary adjustments of pH. This being said, I do, however recommend testing before you add fish, periodically during the first year and every other week beginning the second year of maturity. If you make any changes in pH be sure you know the total number of gallons! Volume should be measured, not calculated.

Carbonate Activity – What do the mean by Buffering?

Carbonates buffer pH by "capturing and releasing" free hydrogen and raising Total Alkalinity. Think of it this way, we have already learned that a high concentration of hydrogen ions means we are experiencing a low pH. In this case the carbonates come over and grab some hydrogen ions helping to lower the number of free hydrogen ions, thus raising the pH. If the situation was reversed the carbonates would let go of their captive hydrogen ions, increasing the overall number of free H ions and lowering the pH.