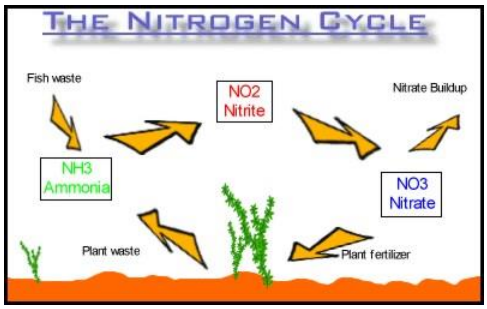
Information and pictures provided by Seachem™, Sera®, Caribsea™, Rocky Mountain Aquatics, and The Fish Crew



Essential tasks of water plants in an aquarium

Together with the bacteria inhabiting the bottom gravel, plants form a powerful purification cycle.

Plants use the ammonium and nitrate created from fish waste and other sources, thereby detoxifying the water.

Plants withdraw the nutritional basis that supports algae. During photosynthesis, plants use carbon dioxide (CO_2) as a nutrient and, in turn, enrich the water with oxygen, which is essential for the fish.

Plants provide shelter. Fish fry need dense-growing plants as well as finely shaped plants in which to hide from their hungry fellow inhabitants.

A densely planted aquarium will make you enjoy the exotic underwater world.

Light energy

for photosynthesis; to ensure the plant can take up carbon dioxide. Just as in nature, plants need light to live. During photosynthesis, plants use light energy during the day to form carbohydrates (= sugar) from CO_2 and water for growth, and they release oxygen as a waste product, which is vital for the aquarium biotope.

Color Spectrum: 6000 – 7000 °K

Lighting Period: 8 – 12 hours per day

Carbon dioxide (CO_2)

to form the plant body and to enhance the breakdown of pollutants.

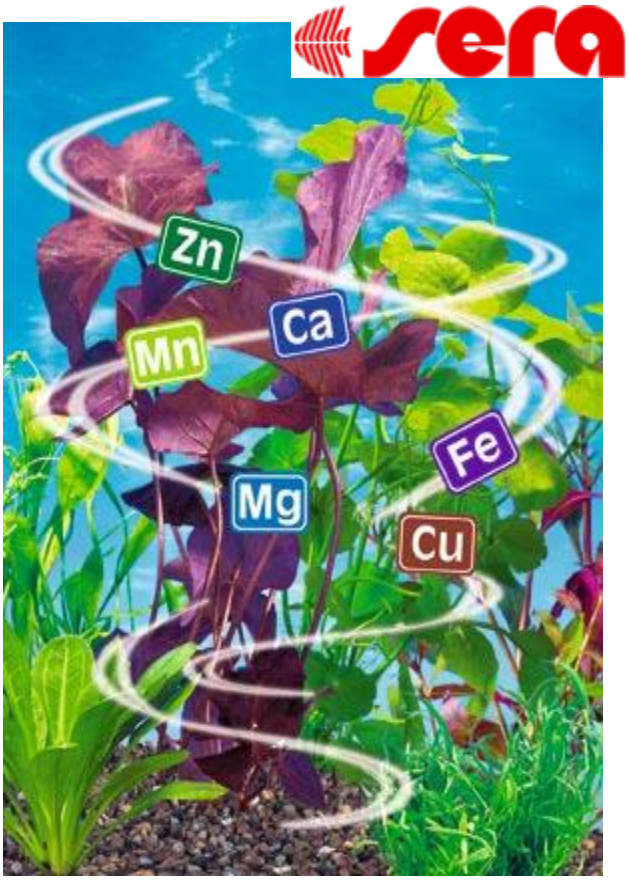
CO_2 – The gas that makes plants grow

During photosynthesis, plants build the organic compounds needed for growth only if the CO_2 supply in the aquarium is sufficient and correct lighting is available. To do this, we need to ensure a constant supply of CO_2, often through supplementation.

Carbon dioxide (CO_2) is the waste product that humans and animals exhale. CO_2 exhaled by the fish may be sufficient in aquariums with few plants and slow plant growth. In most cases, however, there is not enough natural CO_2 available in an aquarium. What carbon dioxide there is, will also escape the water by the constant agitation of the filter or an air stone.

Lush growing, varied plant stock in the aquarium, including fast-growing plants, usually requires an additional CO_2 source. Plants often grow poorly, fish lack oxygen, the pH value can rise too high, and snails can spread more rapidly when CO_2 is low. CO_2 also dissolves lime, making snail shells fragile and enabling fish to eat the snails. The more robust the plants, the more algae-increasing nutrients they consume, thus sparing you from algae problems in your aquarium. Furthermore, CO_2 has even more positive effects on the aquarium biotope. It stabilizes carbonate hardness, and lowers and stabilizes the pH value.

Fertilizers / Minerals / Nutrients



Major nutrients (macro elements)

Aquatic plants need relatively large amounts of these nutrients:

- Nitrogen (N)
- Phosphorus (P)
- Sulfur (S)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)

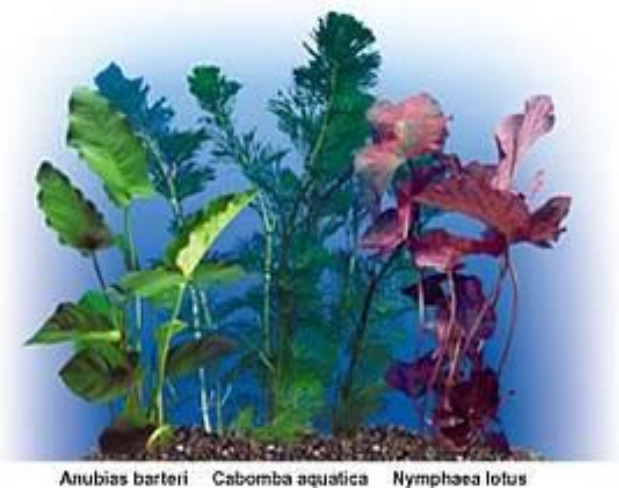
Trace elements (micro nutrients)

Although aquatic plants require only small quantities of these trace elements, they are just as important as the major nutrients for plant life.

The most important trace elements are:

- Iron (Fe)
- Copper (Cu)
- Manganese (Mn)
- Zinc (Zn)
- Boron (B)
- Molybdenum (Mo)
- Vanadium (V)

Nutrient Uptake


Anubias barteri Cabomba aquatica Nymphaea lotus

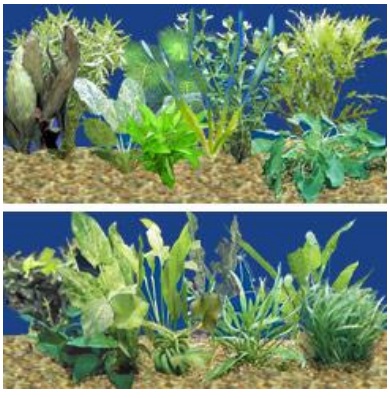
Through the leaves

Plants with particularly fine leaves such as Cabomba take up their nutrients through the foliage. Liquid fertilizers are needed to provide nutrients in an available form for the plants. This type of fertilization requires a constant gentle flow of water to ensure the nutrients are dispersed evenly to all parts of the plant.

Through the roots

The roots of aquatic plants stabilize the plant in the ground, but they also take up and store nutrients for future use. Some plants, such as the Cryptocoryne, Anubias and Echinodorus species, use their roots as the main source of acquiring nutrients.

Element	Major Function	Sign of Deficiency
Oxygen	Major component of organic compounds	n/a
Carbon	Major component of organic compounds	Stunted growth, affects whole plant
Hydrogen	Major component of organic compounds	n/a
Nitrogen	Component of nucleic acids, proteins, hormones, coenzymes, etc	Stunted growth, chlorosis, affects whole plant
Potassium	Cofactor in protein synthesis, osmosis, operation of stomata	Chlorosis, necrosis, weak stems and roots, older leaves most affected
Calcium	Formation and stability of cell walls, maintenance of membrane structure and permeability, activates some enzymes	death of shoot and root tips, young leaves most affected
Magnesium	Component of chlorophyll, activate many enzymes	Chlorosis, older leaves most affected
Phosphorus	Component of nucleic acids, phospholipds, ATP, several coenzymes	Stunted growth, plant dark green, affects entire plant
Sulfur	Component of proteins, coenzymes	Chlorosis, with veins remaining dark and tissue between light, affects young leaves
Sodium	Osmosis, charge balance, used in C4 pathway of photosynthesis	
Chlorine	activates photosynthetic elements, functions in water balance	Wilted leaves, stunted roots, chlorosis, necrosis
Iron	Component of cytochromes, may active some enzymes	chlorosis of tissue between veins, stems short and slender, affects young leaves
Boron	Cellular membrane function, root growth, flowering, carbohydrate transport, nucleic acid synthesis	Death of stem and root apical meristem, leaves twisted, young tissue most affected
Manganese	Active in formation of amino acids, activates some enzymes, photolysis of water	Chlorosis of young leaves, with smallest veins remaining green, necrosis between veins
Zinc	Active in formation of chlorophyll, activates some enzymes	Reduced leaf size, shortened internodes, chlorosis spotted leaves, older leaves most affected
Copper	Component of many redox enzymes	Young leaves dark green, twisted, wilted, tip remains alive
Molybdenum	Essential for nitrogen fixation	Chlorosis, twisting, death of young leaves
Cobalt	Enzyme cofactor	
Nickel	Component of enzyme urease	
Bromine	Used in some enzymes	
Rubidium	Enzyme cofactor	
Tin	Enzyme cofactor	
Vanadium	Enzyme cofactor	



Recommended Levels of Nutrients

Nitrate 5ppm – 10ppm

Phosphate 0.5ppm – 1.0ppm (or 10% of Nitrate)

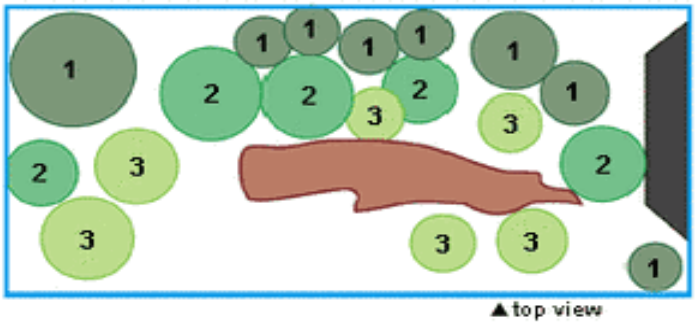
Potassium 20ppm

Iron 0.1ppm – 0.5ppm

Layout

Make sure you have provided sufficient hideaways for your fish. Caves, which can very easily be built from slab-shaped stones or stones with holes, are particularly well accepted.

Large plants should be grown at the back of the aquarium; otherwise they will obstruct the view. In the foreground, small and lawn-forming plants should be grown.

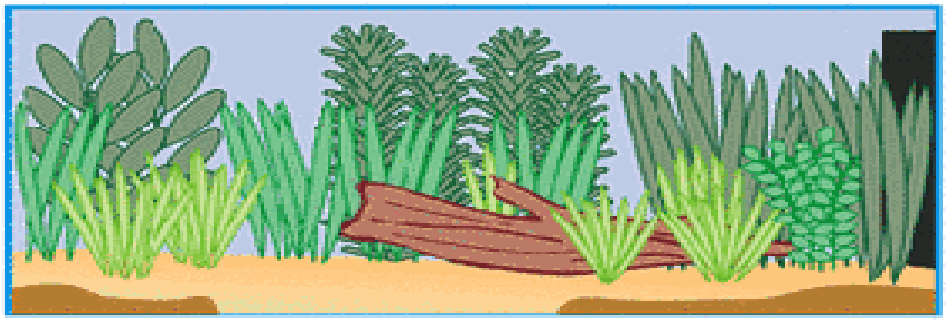


▲top view

(1) Plants in the background
(2) Plants in the center
(3) Plants in the foreground

By carefully planning your decoration design, technical equipment in the aquarium (filter, heater, etc.) can be hidden in such a way that they become "invisible" or at least quite unobtrusive. The water must flow around the heater in order to have the warmth distributed evenly.

Include a sufficiently large free zone as swimming space for lively fish.


▲front view

Adding Plants

Shorten the plant's root tips slightly with a pair of sharp scissors before planting, and remove decayed or frayed leaves.

Dig a planting hole with your finger into the gravel. When needed, add a root/plant tab, to stimulate root development.

Carefully put the roots into the hole and cover them with gravel. Press the gravel carefully and pull the plant slightly, so that the roots face downwards again.

Snail Control

Most snails will cause harm to plants in the aquarium. The majority of snails will eat algae as well as the plants in the aquarium. Malaysian Trumpet Snails are the exception. These are cone shaped snails that will not consume plants and do a great job of keeping the gravel stirred up and aerated. The down side to these snails is they can reproduce in great numbers. It is possible to take Olive Nerite snails, usually associated with saltwater, and acclimate them to freshwater. These snails will do a great job with algae, will not eat your plants, and are not able to reproduce in freshwater.

The best method of ridding the aquarium of snails is with some type of snail eating fish. Clown loaches and other botias do a great job. Clown loaches will grow quite large and this must be taken into consideration. A dwarf botia, such as botia sidthimunki, reaching only 3" in length, or striata botia is a great fish to rid the aquarium of pesky snails. The last resort to control snails is chemical. This method should be considered a last resort after all other attempts and methods have failed. A very week solution of copper can be used to kill the snail population. The down side to this method is that copper can be harmful to both fish and plant populations. Some plant species can be very sensitive to copper, even very small doses; can kill these plant species completely.

Algae

Algae are not only unattractive, but it also causes complications with the plants photosynthetic cycle. An alga tends to get out of control in conditions of high nitrate and phosphate. There are many chemical controls of algae, but the first step is not to let nitrate and phosphate levels get out of control. Plant your aquarium right from day one. A densely planted tank from the beginning with fast growing plants will help inhibited algae growth. Always introduce algae eating organisms.

Type of algae	Cause	Solution
Black Beard Algae (BBA)	Low CO2	Add CO2, trim, spot treat with Excel
Blue Green Algae (BGA)	Low nitrate	Blackout + add nitrate
Cladophora	Low nitrate + Low CO2	Add nitrate, add CO2
Diatoms	Excess silicates, Low light	Wait, add catfish, use RO water/sponge
Green Dust Algae (GDA)	Spores	Wait out life cycle, remove + Water change
Green Spot Algae (GSA)	Low phosphate + Low CO2?	Add phosphate, possibly add more CO2
Green Water (GW)	Ammonia + high light	Reduce light, Wait, Small water change, UV filter
Hair Algae	Excess nutrients, silicates	Water change, Excel, feed less, is something limited?
Staghorn	Ammonia + low CO2	Remove, Water change, protect filter, Excel
String Algae	Excess nutrients	Water change + get biofilter working

Algae Eaters

Cherry Shrimp

Otocinclus

Dwarf Plecostomus Species

(Clowns, Bristlenose, Rubber, Albino)

Farlowella

Snails

Flying Fox Siamensis

(aka Pink Fox)

Algae Eating Shrimp

How to ID a TRUE Flying Fox Siamensis

CO_2 TABLE

pH / KH	6.0	6.2	6.4	6.6	6.8	7.0	7.2	7.4	7.6	7.8	8.0
0.5	15	9.3	5.9	3.7	2.4	1.5	0.93	0.59	0.37	0.24	0.15
1.0	30	18.6	11.8	7.4	4.7	3	1.86	1.18	0.74	0.47	0.3
1.5	44	28	17.6	11.1	7	4.4	2.8	1.76	1.11	0.7	0.44
2.0	59	37	24	14.8	9.4	5.9	3.7	2.4	1.48	0.94	0.59
2.5	73	46	30	18.5	11.8	7.3	4.6	3	1.85	1.18	0.73
3.0	87	56	35	22	14	8.7	5.6	3.5	2.2	1.4	0.87
3.5	103	65	41	26	16.4	10.3	6.5	4.1	2.6	1.64	1.03
4.0	118	75	47	30	18.7	11.8	7.5	4.7	3	1.87	1.18
5.0	147	93	59	37	23	14.7	9.3	5.9	3.7	2.3	1.47
6.0	177	112	71	45	28	17.7	11.2	7.1	4.5	2.8	1.77
8.0	240	149	94	59	37	24	14.9	9.4	5.9	3.7	2.4
10.0	300	186	118	74	47	30	18.6	11.8	7.4	4.7	3
15.0	440	280	176	111	70	44	28	17.6	11.1	7	4.4
20.0	590	370	240	148	94	59	37	24	14.8	9.4	5.9

CO_2 measured in mg/l

- TOO MUCH CO_2
- OPTIMUM LEVEL
- PERFECT LEVELS FOR PLANTS
- TOO LITTLE CO_2

A vital element for all plants is carbon. Terrestrial plants obtain this element mainly from carbon dioxide ($C0_2$) in the air, aquarium differ in this aspect. They obtain carbon from inorganic carbon that can be found in the aquarium water. These can be in the form of carbon dioxide, carbonic acid, and others. $C0_2$ and other carbon molecules are not usually found in a great abundance in aquarium water. They may have to be added for plants to thrive. This may be accomplished by the addition of $C0_2$ into the aquarium.

$C0_2$ will cause the water in the aquariums pH to drop. The plants properly using this $C0_2$ will cause the pH to increase. This cycle will create a stable pH value and allow the plants to photosynthesize. Monitoring the pH is an essential test for any planted aquarium. A good planted tank should have a pH value of 6.8.

The next factor to be concerned with is KH (carbonate hardness, or alkalinity, or buffering capability). An aquarium with a low KH value will have a hard time maintaining a constant pH. Large pH swings can wreak havoc on any aquarium. While a tank with too high of a KH will not be able to keep the carbon in a usable form for the plants. When the carbon is not usable by the plants the carbon will precipitate as lime. This is the white crust that will form on the plants' leaf surfaces. To maintain a good balance we look for a KH value between 3° and 5°.

A Suggested Dosing for a Planted Aquarium

Day of the Week	Product	Dose
Day 1	Flourish	1 cap per 60 US gallons (240 L)
	Flourish Excel	1 cap (5 mL) per 10 US gallons (40 L)
	Flourish Iron	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Phosphorus	1/2 cap (2.5 mL) per 40 US gallons (160L)
	Flourish Nitrogen	1/2 cap (2.5 mL) per 40 US gallons (160L)
Day 2	Flourish Trace	1 cap (5 mL) per 20 US gallons (80 L)
	Flourish Excel	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Iron	1 cap (5 mL) per 50 US gallons (200 L)
Day 3	Flourish Potassium	1 cap (5 mL) per 30 US gallons (120 L)
	Flourish Excel	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Iron	1 cap (5 mL) per 50 US gallons (200 L)
Day 4	Flourish Trace	1 cap (5 mL) per 20 US gallons (80 L)
	Flourish Excel	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Iron	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Phosphorus	1/2 cap (2.5 mL) per 40 US gallons (160L)
	Flourish Nitrogen	1/2 cap (2.5 mL) per 40 US gallons (160L)
Day 5	Flourish Potassium	1 cap (5 mL) per 30 US gallons (120 L)
	Flourish Excel	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Iron	1 cap (5 mL) per 50 US gallons (200 L)
Day 6	Flourish	1 cap per 60 US gallons (240 L)
	Flourish Excel	1 cap (5 mL) per 50 US gallons (200 L)
	Flourish Iron	1 cap (5 mL) per 50 US gallons (200 L)
Day 7	Prime	Use 1 mL per 10 US gallons (40 L) to dechlorinate water
5% Water Change	Alkaline Buffer	Use as necessary to establish desired pH and KH
	Acid Buffer	Use with Alkaline Buffer as necessary to establish desired pH
	Equilibrium	Use as necessary to establish desired GH

Flourish™ is a comprehensive plant supplement for the natural freshwater aquarium. It contains a rich assortment of important micro elements, trace elements and other nutrients. These include calcium, magnesium, iron and other important elements that have been shown to be beneficial to aquatic plants.

Flourish Excel™ is a source of bioavailable organic carbon. All plants require a source of carbon. This is typically obtained from CO_2, but, may also be derived from simple organic compounds (such as photosynthetic intermediates). Therefore, one can derive a substantial benefit with the use of Flourish Excel™ either alone or in conjunction with CO_2 injection. Flourish Excel™ also has iron reducing properties which promote the ferrous state of iron (Fe^{+2}), which is more easily utilized by plants than ferric iron (Fe^{+3}).

Flourish Iron™ is a highly concentrated (10,000 mg/L) ferrous iron (Fe^{+2}) gluconate supplement. It should be used in those cases where the iron requirements exceed that which can be delivered by Flourish™ at the recommended dose or signs of iron deficiency appear (such as short and slender stems or yellowing between veins.) Plants are able to much more easily derive a benefit from Flourish Iron™ than from EDTA-iron sources because all EDTA iron is in the ferric (Fe^{+3}) state. Since plants require iron in the ferrous state, additional physiological energy must be expended in order to extract the ferric iron from EDTA-iron and then convert it to the ferrous form. Contains no phosphate or nitrate.

Flourish Potassium™ contains 50,000 mg/L of potassium suitable for the natural planted aquarium. Potassium is one of several elements that are vitally important to maintaining a vigorous level of growth in a planted aquarium. Potassium can become depleted in a rapidly growing system or when the source water has a low mineral content. In these cases potassium could become the limiting factor to growth. Use Flourish Potassium™ to prevent potassium depletion (signs of which include yellowing in older leaves) and maintain the highest level of growth.

Flourish Nitrogen™ is one of the main three macro nutrients (nitrogen, phosphorus, potassium: NPK) required by plants and can often become the limiting factor to growth in a flourishing system. Flourish Nitrogen™ is a concentrated (15,000 mg/L) blend of nitrogen sources. It provides nitrogen in both the nitrate form and the plant-preferred ammonium form. However, no free ammonia is released because the ammonium in Flourish Nitrogen™ is complexed and unavailable until utilized by the plants. Flourish Nitrogen™ also provides nitrate for those plants that can readily utilize nitrate as well. For maximum benefit use with Flourish Phosphorus™ and Flourish Potassium™.

Flourish Phosphorus™ is one of the main three macro nutrients (nitrogen, phosphorous, potassium: NPK) required by plants and can often become the limiting factor to growth in a flourishing system. Flourish Phosphorus™ is a safe solution (4500 mg/L phosphate) of potassium phosphate that takes the guess work out of phosphate dosing. Unlike competing products that mix nitrate and phosphate in a fixed ratio, Flourish Phosphorus™ (being nitrate free) allows you to dose phosphorus according to the needs of your plants without the risk of overdosing nitrates. When used as directed Flourish Phosphorus™ will enhance and accelerate the growth of aquatic plants without enhancing algae growth. For maximum benefit use with Flourish Nitrogen™ and Flourish Potassium™.

aquavitro®

a premium line from Seachem

unleash **plant** growth.

5549

premier™

premier™ is a conditioner specifically designed for the planted aquarium. It removes chlorine and chloramines while adding potassium. premier™ is non-acidic and will not impact pH. Use at start-up and whenever adding or replacing water.

premier™ is a concentrated solution of potassium thiosulfate which removes both chlorine and chloramines. **Although a thiosulfate-based conditioner is not recommended for saltwater aquaria because of the ammonia produced when it reacts with chloramines, it is perfect for the planted aquarium. The ammonia produced from chloramine by premier™ is predominantly in the ammonium form, and is thus rapidly scavenged by plants.** It also serves as a minor source of potassium.

envy™

envy™ is a comprehensive carbohydrate, vitamin, amino acid, and polyunsaturated fatty acid supplement that addresses the micro and trace nutritional requirements of plants. **envy™ contains ascorbic acid in a base of chlorella that contains a rich assortment of amino acids and vitamins.**

propel™

propel™ is a concentrated (10,000 mg/L) source of ferrous iron. This ferrous iron is **a mixture of readily available and time-released iron.**

If iron is provided in the ferric form (Fe^{3+}) then it must be reduced by the plant to the ferrous form (Fe^{2+}) before it can be utilized. This process of conversion (known as reduction) requires the plant to expend physiological energy. **propel™ provides iron already in the ferrous form thus enhancing iron utilization.** In addition, propel™ contains a reducing agent that helps convert any iron present (such as iron from substrate) into the ferrous form.

synthesis™

Nitrogen comes in a variety of forms (nitrate, ammoniacal, urea). While plants can use all three forms the form that is preferred varies by species. Thus nitrogen supplements derived solely from just one form (nitrates) will not be as effective as a supplement that provides all three forms.

synthesis™ is a concentrated (32,000 mg/L N) nitrogen source. **synthesis™ is unique in that it provides nitrogen in all three forms. Approximately 50% of the nitrogen in synthesis™ is derived from an organic source (urea), while the remaining nitrogen splits at about 25% each from nitrate and ammoniacal sources.**

activate™

activate™ is a concentrated (6,000 mg/L P) phosphorus source. When used as directed, **activate™ will enhance and accelerate the growth of aquatic plants without enhancing algae growth.** For maximum benefit, use with synthesis™.

activate™ is made with potassium salts of various phosphates, and is therefore a source of potassium as well. It contains 8,800 mg/L of potassium.

When used with aquavitro's nitrogen supplement, synthesis™ at the same dose (7 mL/250 US gallons) both products provide nitrogen and phosphorus in a 5:1 N:P ratio.

mineralize™

General hardness is the divalent metal cation content of the water. In most water this is comprised primarily of calcium and magnesium. Soft water has a low concentration of dissolved divalent cations, hard water a high concentration.

The native environment of some plants (Cryptocoryne, Aponogeton, etc.) is soft, whereas others (Sagittaria subulata, Riccia fluitans, etc.) are more acclimated to hard water. In order to replicate these environments it may be necessary to adjust hardness.

mineralize™ is a blend of divalent salts designed to restore or increase general hardness.

carbonate™

Carbonate hardness, (KH), is a measure of the bicarbonate & carbonate content of the water. Carbonate hardness contributes to pH stability and can also act as a CO_2 backup reserve if CO_2 levels fall too low.

carbonate™ is derived from potassium bicarbonate. It increases both carbonate hardness and potassium. The concentration of carbonate™ is 2000 meq/L (5600 dKH). In addition, it contains 78,300 mg/L potassium.

For sale in indpendent retail stores only.
No online sales.

www.aquavitro.com