PLANT CARE

Live aquarium plants are a worthwhile addition to the fish tank. In a well planted tank, the fish have better colors, live a more natural life, and appear more comfortable than in an unplanted tank. Though they need more care than plastic replicas, live plants can be kept with few problems as long as there is plenty of light and no plant-eating or plant-destroying fish.

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Photosynthesis
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Photosynthesis is the process by which plants convert carbon dioxide gas and water are converted with the help of light energy into glucose (energy) and oxygen gas. This process can be expressed in the equation:

6C2O + 6H2O + sunlight => C6H12O6 + 6O2

Thus in an aquarium during the day, plants use the carbon dioxide, produced by fish, and water to produce oxygen and energy. The oxygen is used by fish for respiration. At night, there is no sunlight or artificial for the plants to carry out photosynthesis, so the plants must rely on respiration to make energy. So, plants take in oxygen and produce carbon dioxide. Because of nighttime plant respiration, the carbon dioxide level in an aquarium rises at night, but once the light is turned on, the carbon dioxide levels drop due to plant photosynthesis.

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Substrate
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Follow the suggestions under "Gravel" in the aquarium section for gravel set-up. In most cases, plants do best in fine gravel with some sort of base fertilizer. Base fertilizer is not required, but is recommended. Iron rich clay fertilizers like laterite, and other fertilizers manufactured for aquatic plants are suitable.

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Lighting
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One of the most important ingredients to a successful plant aquarium is strong lighting. As a general rule, 2-3 watts per gallon is sufficient for a well-planted aquarium. Often light is measured on a scale of lux. The following table gives the light requirements in terms of lux for plants growing at different water levels:

Light

Type	Lux	Watt/G	Examples
subdued	100-500	1-2	Cryptocoryne, Vesicularia dubyana
moderate	500-1000	2-2.5	Sagittaria, Echinodorus
bright	1000-1500	2.5-3	Aponogeton, Bacopa
very bright	1500+	3+	Cabomba, Lemma, Salvinia

Fluorescent bulbs have proven to be the most practical bulb for lighting planted tanks. However, in tanks deeper than 20" (50 cm), most fluorescent bulbs are not strong enough to illuminate the tank sufficiently, so mercury vapor lamps can be used. For mercury vapor lamps, use about 6.25 watts per inch (2.5 cm) of tank length.

Be aware that the intensity of fluorescent tubes decreases subtly, with time. Thus one tube should be replaced every six months.

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Water

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Most aquarium plants can be kept in water with a hardness from 4-12 dH, and a pH from 6.5-7.2. For specific species, see the individual descriptions. The water should be kept as clean and clear as possible because free debris can settle on plant leaves or cloud the water, interfering with light intensity. Very few aquatic plant species can survive in brackish water.

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Nutrients

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Plants require macro- and micro nutrients to grow. Macro nutrients are substances that are required in relatively large amounts such as nitrates, phosphates, and sulfates. These nutrients usually occur naturally in the aquarium from tap water and fish. When these levels rise to excessive amounts, an "algae bloom" can result. Nitrate levels rise do to their production by fish. Thus these macro nutrients need not be added to the aquarium.

Micro nutrients are elements that are required in trace amounts. Micro nutrients important to plants include copper, iron, manganese, boron, zinc, and calcium. These elements are needed in only the smallest amounts, and excess can prove harmful.

The following table reviews some of the major nutrients important to aquatic plant growth. (The macro nutrients are marked with an asterisk*)

Nutrient - Function

- Carbon* - the basic block of carbohydrates, which plants use for energy
- Oxygen* - important in plant respiration at night
- Hydrogen - (in the form of water) is needed for nutrient transport, among other functions
- Nitrogen* - (usually in the form of ammonia or nitrate) necessary for protein synthesis
- Phosphorous* - promotes flower development
- Sulfur* - used in protein synthesis
- Iron - used in chloroplast formation (chloroplasts are the structure in which photosynthesis occurs.

When there is a deficiency of nutrients, the plants suffer. If the leaves yellow faster than usual, there could be a deficiency of nitrogen or sulfur. If the leaves yellow starting at the tips or the leafs seem especially brittle, an iron deficiency should be suspect. Evidence of an over fertilization of iron or a manganese, phosphorous, or potassium deficiency is yellow spots on the leaves.

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Fertilization

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Because macro nutrients are usually available naturally in tanks, an all-around plant fertilizer cannot be recommended for aquarium plants. Instead use preparations of "trace elements" which are specially prepared for aquatic plants and are widely available in pet stores. Never overdose with a fertilizer because plants and fish can be damaged. Do not purchase a fertilizer than includes phosphate or nitrate, because horrible algae problems may arise. Fertilizers are commonly available in liquid and pelleted forms.

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Carbon dioxide

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Carbon dioxide is used by plants for photosynthesis and is a fundamental compound to the success of a planted aquarium. Carbon dioxide is present in aquariums as a byproduct of fish respiration and nitrification, and dissolved in the water from the atmosphere. Carbon dioxide levels should range from 5-15 Mg/l, once the level surpasses 20 Mg/l, fish may be harmed. Remember that aerating the water quickly causes carbon dioxide levels to decrease. If the tank is heavily planted and lightly stocked with fish, or if the water is hard, carbon dioxide fertilization may be necessary. However, carbon dioxide fertilization is usually not required for a beautifully planted aquarium. Carbon dioxide can be added to the fish tank using a carbon dioxide fertilizing system. Carbon dioxide fertilization is more popular outside the United States than it is within.

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Filtration

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Almost any filtration system (mentioned in the aquarium section) will work in a plant tank. The main requirements of the filtration system are: 1) that it does not create much water disturbance, because precious carbon dioxide will be lost; (2) that the filter remove floating particles that may block the lighting or settle on plant leaves; (3) and that the filter create some current to keep nutrients moving through the water and to prevent debris from settling on leaves.

Undergravel filters are not the best choice because the air bubbles create surface disturbance and the filter plate limits substrate size and composition.

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Planting

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Before planting the aquarium, make a rough sketch of how the tank should look. Include rocks and wood structures and plants so that there is a plan to follow.

Plants fall into different categories as to how tall they grow and their shape:

Foreground: Foreground plants are small, low growing species that often form carpet-like mattings by producing numerous runner plants. Foreground plants often inhabit shallow water and may require bright lighting. Plant foreground plants in front of middle ground and background plants.

Middle ground: Middle ground plants are medium sized species that can be used behind foreground plants, but in front of background plants. Middle ground plants can block unsightly stems of background plants.

Background: Background plants are usually tall and can be used to block out heaters, filters, hoses, and wires. Background plants are generally fast-growing species that require less light than foreground and middle ground species.

Bunch Plants: Bunch plants are usually middle ground or background species that look good in groups of several. Bunch plants are often easily propagated by cuttings.

Specimen Plants: Specimen plants are usually large, decorative species that are planted singly in the middle ground or background. Specimen plants are often used as a focal point and may be highlighted with a spot-light.

Contrast Plants: Different-looking plants can be used as a contrast to the other plants in the tank. Red-leafed plants can be used as a color contrast to green plants, while plants with pointed leaves can be used as a shape contrast to those with large round leaves. When contrasting plants, place plants with similarities in color, size, or shape away from one another, while planting plants with differences closer together.

Floating Plants: Floating plants require plenty of light, but must protected from leaf burn by leaving distance between them and the bulb. Floating plants often propagate very quickly by division and in a short matter of time, take over and aquarium and block out light. Floating plants should be kept out of the light path of plants below that require a lot of light.

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Propagation

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Plants have several means of reproducing. Some species reproduce amazingly fast, taking over an entire tank in a matter of weeks, while others do not appear to propagate themselves at all.

Cuttings: Cuttings are the easiest way to propagate plants. Simple cut a lengthy (6-8") section of stalk from the plant and plant it in the gravel. Plant cuttings with at least 1" (2.5 cm) of the stem under the substrate. Remove the leaves on the section that will be in the substrate. Plant tubers and bulbs at a 45° angle in the substrate with the growing tip pointing out of the gravel. Both the cutting and the original plant should continue to grow. Most bunch

plants can reproduce by cuttings.

Runners: Many aquarium plants, especially foreground and Sword plant species produce outgrowths known as runners. These new shoots are formed on stems and usually grow along the substrate or within the substrate. Plants that reproduce by runners (daughter plants), are often prolific.

Rhizome: The roots of some plants produce side-shoots. These plants can be propagated by cutting the rhizome into pieces. Be sure to include some leaves and some roots with the rhizome. Replant the cut sections along the surface of the substrate. These sections should root.

Adventitious plants: Adventitious plants are plantlets that arise from the mother plant. The mother plant produces a number of plantlets with drift free of the mother plant, and root on their own. Adventitious plants will either be released by the mother plant or can be cut when the plantlets reach a suitable size. Also referred to as "division."

Seeds: Plants that flower produce seeds only after pollination, in nature, usually be insects. In aquaria, use a fine brush to transfer pollen from the stamens to the stigmas.

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Pruning

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Like land plants, aquarium plants need to be pruned and thinned on a regular basis. Many of the taller, stalky species will actually grow out of the water if they are left unpruned. Other tall species will grow along the water surface and block out light to lower species if they are not trimmed. Prunings of many species, can be replanted. With leafy plants, like Swords, the large, outer leaves may need to be removed to make room for new growth. Plants with floating leaves like Nymphaea species, need to be cut back so that the light is not blocked from lower plants. Cut the upper leaves until only the lower leaves remain. When plant branches become dense, they should be thinned by removing some branches.

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Plants to avoid

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There are several plants sold as aquatic plants in pet stores that are not actually aquatic. These plants do not grow for long underwater and eventually end up polluting the tank when they die. Among some of the commonly available nonaquatic species are: Aglaonema, Brazilian Sword, Cherry Hedge, Draceana (Princess Pine), Green Hedge, Mondo Grass, and "palms."

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Algae

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Almost every aquarium is plagued at some point by an "algae bloom." "Algae blooms" can be fueled by excess light, especially sunlight, and excess nutrients, especially nitrate and phosphate buildup. Thus "algae blooms" can often be prevented by regular water changes and placing the tank away from direct sunlight.

There are several types of algae common in the aquarium:

GREEN ALGAE

Green thread (filamentous) algae: Green thread algae forms long, green, filaments which often grow from plants. Thread algae needs abundant light to thrive. Thread algae can be damaging to the aquarium by taking important nutrients that aquarium plants require. Thread algae can be controlled by algae-eating fish or by manual removal.

Pelt algae: Pelt algae adheres to plant leaves by a single filament an reaches a length of 0.8" (2 cm). Pelt algae usually develop in water with a high nitrate content and can cause plant leaves to die. To eradicate pelt algae, remove the filaments manually, introduce algae-eaters (Flying Foxes) or snails (ramshorn). Regular water changes slow pelt algae growth.

Suspended algae: Suspended algae usually resembles green water and is comprised of Volvox. Suspended algae is most commonly introduced when pond foods are fed. Suspended algae can be removed by a series of large water changes, filtering with a diatom filter, or using UV light. Algicides can also be used to get rid of suspended algae.

Green spot algae: A small, dark green algae that forms small, round spots on the leaves of plants and the tank glass. This species thrives in poor and unstable water conditions. Algae eating fish and snails can rid the aquarium of green spot algae. The stabilization of water conditions helps slow green spot algae growth.

Green bunch algae: This algae forms bunches up to 1.2" (3 cm) long. Green algae is most prevalent in tanks with excessive lighting and fertilization. Green bunch algae can be removed by hand or algae eating fish.

BLUE-GREEN ALGAE

Blue-green algae: Blue-green algae form a layer that covers plants and gravel. Blue-green algae are fueled by excessive illumination and high nitrate and phosphate levels. Blue-green algae can produce toxins that are harmful to fish. Blue green-algae are often refused by algae-eating fish because of its bad taste. Apple snails can slow blue-green algae growth, but the best treatment is 5-7 days of total darkness combined with several large water changes.

RED ALGAE

Beard algae: Beard algae forms long (up to 6"-15 cm), black to dark green, branches that are introduced with new aquarium plants and are prominent with high nitrate levels and/or carbon dioxide deficiency. Beard algae firmly attaches to plant leaves, so manual removal is damaging to the plant. Algae-eating fish can eliminate beard algae as can carbon dioxide fertilization.

Black spot algae: Black spot algae form small, black spots on plant leaves. The cause of black algae is unclear, but excess nutrients (nitrate) and light help its spread. Control is very difficult, the best means to take is to remove affected leaves.

Black brush algae: Black brush algae forms dark, muddy-green bunches that adhere leaves, rocks, gravel, and wood. This red algae causes leaves to die off and thrives in acidic water with a high nutrient load. Short forms can be

removed by algae-eating fish, but long forms are best combated by carbon dioxide fertilization.

DIATOMS

Diatoms: Diatoms develop in aquaria that are poorly illuminated, have a high load of nitrate and phosphate, and a pH above 7. Diatoms forms a brownish layer on plants, rocks, and glass and can be removed by snails and algae-eaters. Diatoms die off when water conditions improve and lighting intensity is increased.

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Algicides

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Algicides are chemicals that can be used to eliminate algal growth in the aquaria. Algicides work on a limited range of algae including filamentous, blue-green, and diatoms. If possible, seek non-chemical means to combat algae as many algicides do have side affects towards plants.

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Trouble-shooting with Plants

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Besides algal infestations, plants can suffer other ailments, especially when the water conditions are not favorable. Water with incorrect properties can cause as much or more damage to a plant than nutrient deficiency. If plants begin to wane (i.e. prematurely yellowing and losing leaves, leaf damage), first check that the water conditions are in order. If they are, see the chart below for help.

Symptoms	Possible Cause	Action
-slender stalks -smaller leaves -lower leaves on plant stem -lower leaf loss	insufficient lighting	Make sure that the plants have the right illumination period. Change the light bulbs if they have been used for longer than a year. Make sure that the lights are strong enough for the types of plants kept.
-small brown spots, developing into holes -yellowing leaves	high nitrate content from lack of water changes	Make a series of moderate water changes.
-small, irregular holes with sharp edges in otherwise seemingly healthy leaves	snail feeding	Remove snails by hand.
-stunted growth -premature die off	carbon dioxide deficiency	Start fertilizing with carbon fertilization. Decrease aeration.

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Recommended Aquatic Plant Resources

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Check out the following sites for quality information on aquarium plants:

http://www.csd.net/~cgadd/aqua/articles.htm
http://www.aquabotanic.com/index2.cfm
http://www.thekrib.com/Plants/
http://home.infinet.net/teban/
http://www.tropica.com/default.asp