

API® Lesson 3 | Growing Lush Aquatic Plants

This lesson plan provides how to easily setup and maintain a planted aquarium ecosystem. A properly planted aquarium is one-step closer to a simulated natural ecosystem balancing fish and plants providing better water quality.

For Instructor/Teacher/Parent

Make sure to read through the entire lesson plan before beginning this with students/family members as materials may need to be purchased and information prep will need to be done.

Learning Objectives

After completing the activities outlined in this lesson plan, students should be able to:

- Explain the components needed to establish a planted aquarium
- Clearly explain the difference between aquariums with and without plants
- Discuss the importance of low to moderate water hardness
- How to test water and what the test results mean and how to correct them
- Clearly explain the feed cycle for plants
- Understand the basics of nutrition for plants

Length

This activity will take 4 to 6 weeks for completion on average.

Materials

- Aquarium, Aquarium Cover, Aquarium Light, Aquarium Stand (if you have completed lesson 1, you will already have an aquarium set up, but changes might need to be considered like substrate, live plants, plant-friendly fish, lighting, etc.)
- Substrate/Gravel for plants
- Filter
- Heater
- API FRESHWATER MASTERT TEST KIT
- API GH & KH TEST KIT
- Water Conditioners and Bacterial Products
 - API STRESS COAT™ water conditioner - treating tap water and fish conditioner
 - API QUICK START™ - live nitrifying bacteria
 - API STRESS ZYME™ - live cleaning bacteria
- Plant Water Conditioners
 - API ROOT TABS
 - API LEAF ZONE
 - API CO2 BOOSTER
- Fish



Key Terms

Review key terms (printable sheet included at the end of the lesson) with students/family members.

- 1) dGH
- 2) dKH
- 3) PHOTOSYNTHESIS
- 4) pH
- 5) NUTRITION

Warm Up

Ask a couple of questions to warm up for the lesson:

- Why are plants important in aquatic environments?
- Can you think of activities that would bother plants?
- Can you name some kinds of fish that are plant-friendly?
- What is important to plants?

Before You Start

- 1) For this setup we are going to proceed using the basics from the tropical community aquarium ecosystem (see Lesson 1).
 - a) Note: It will be important to determine that the type of fish in your aquarium are plant-friendly. Fish that eat plants certainly are not acceptable but fish that constantly dig are also not acceptable in a planted aquarium. Plant-friendly fish do not eat plants and do not dig aggressively constantly disturbing the plant roots.
- 2) You will need to install lighting that is appropriate for a planted aquarium. The lighting will need to be set on a timer to allow for proper daily daylight and nighttime photosynthetic periods. Remember the depth of the aquarium is also a consideration for how deep the light can penetrate and still be effective.
- 3) Selecting plants and where to locate/place them in the aquarium is important. Some plants grow very tall and large and other will have a lower profile and size. Some plants require high light intensity while others can grow in lower light conditions.

Instructions for Learning Activity

1. Starting with the right water
 - a. Most aquatic plants require water with a low to moderate general hardness level and carbonate hardness.
 - i. The General Hardness should be between 2-7°dGH. General Hardness is the measure of dissolved calcium and magnesium ion concentrations dissolved in water. General Hardness often referred to as GH can be measured in part per million (ppm), milligram per liter (mg/L) or German degrees (°dGH).
 - ii. The Carbonate Hardness (also known as alkalinity) should be between 2-6°dKH. Carbonate Hardness is the measurement of carbonate and bicarbonate ion concentrations dissolved in water. Carbonate Hardness helps stabilize pH in the aquarium. e measured in part per million (ppm), milligram per liter (mg/L) or German degrees (°dGH).
 - iii. Note: It is easy to convert °dGH to ppm or mg/L. To convert °dGH to ppm or mg/L multiply by 17.9. To understand °dGH you would be read as degrees deutsche general hardness.
 - b. Tap water is often too hard or contains excessive levels of nutrients such as phosphate or nitrate. Measure the hardness of tap water and if it is too high you can either run it through a Deionizer (DI) or Reverse Osmosis filter (RO) filter or find a source of water that has a lower hardness. Many local aquarium stores sell DI/RO water which is ideal for planting aquariums.
2. Selecting the correct substrate.
 - a. When selecting substrate for your plants consider the type of material and the size. The substrate has several purposes in the aquarium from providing an area for beneficial bacteria to colonize, provide an aesthetic look for you and the proper size and format for the roots of the plants. The roots are essential for the plant to maintain growth. The roots will have fine hair-like structures that will uptake nutrients. The roots will anchor the plant in the aquarium so it will not float away.
 - i. Common aquarium gravel in #2 or #3 size (.2 to .5 cm) works well in planted aquariums. A material as fine as sand can pack very tight and promote unwanted anaerobic areas. Materials that are not suitable would include calcium carbonate or silica-based materials such as aragonite, crushed coral, shells, and coral sand.
 - ii. The gravel bed thickness should be at least 3 inches (7.6 cm). This will allow the roots to become established and spread appropriately to uptake nutrients.
 - b. **Rinse your gravel to remove fine particles and dust. Then place it in the bottom of the aquarium.**
3. Add your decorations (rocks and driftwood) leaving enough room for your fish to easily swim about and areas for the selected plants to grow. When you first setup your planted aquarium it may seem bare, but by selecting the correct plants, they will grow and fill in the voids.
4. Install your equipment (filter, heater, etc.). The majority of the plants are from the same tropical regions as are your fish and need a heater. Wait before you connect everything to the electric.
5. **Selecting your plants**
 - a. As with fish you will have a large variety of plants to choose from. The most important thing to consider is the amount of space each plant will require, and the intensity of light needed. See the appendix for a guide to just some of the many plants available.
 - b. Fill your aquarium a few inches with water, just enough to cover the substrate. This will make it easier for you to position your plants.
 - c. Now position your plants in the aquarium based on the size they will be when grown, not based on the size they are now.
 - i. Note: Some plants grow long runners such as Vallisneria sp. and Cryptocoryne sp. The runners can spread quite easily throughout the aquarium popping up that you may have a hard time containing in the area you want. One way to aid in controlling where the runners go is to place these types of plants inside a small pot or tray and placing the pot or tray into the gravel. To make the pot or tray aesthetically pleasing cover it with the aquarium gravel just a little bit. When it is time to thin or prune the plant simply remove the small pot or tray and prune or separate the roots. You can then repot the desired plants into the pot and put back into the aquarium.
 - d. Fertilizing the root of your plants is key. Aquarium plants require certain essential nutrients for vibrant growth. If only a single nutrient or trace element is absent your aquarium plants will cease to grow. Feeding plants is easy today as modern fertilization compounds can provide these nutrients. It is best to fertilize the roots and the leaves of

your plants. Be sure to only select fertilizers specifically formulated for aquariums. Fertilizers designed for your garden or house plants should be ruled out as these often supply nutrients at levels that are dangerous to aquarium life.

- i. To grow plants and keep your aquarium life safe add API ROOT TABS and API LEAF ZONE to feed your plants. Now add API ROOT TABS to the base of your plants pushing them midway into the gravel. API ROOT TABS are formulated to supply the key nutrients, including iron and potassium, to help new aquatic plants get off to a vigorous start and to keep established plants flourishing. ROOT TABS are fertilizer tablets designed exclusively for aquarium plants. When placed in the substrate/gravel on a monthly basis, ROOT TABS provide the essential nutrients aquarium plants need, absorbing nutrients through their roots.
6. Fill your aquarium with water.
 - a. Be sure to add a water conditioner such as API STRESS COAT to make your tap water safe for your plants and fish. API STRESS COAT removes chlorine and chloramines from tap water and chelates heavy metals in the water with are harmful to plants and fish. API STRESS COAT aids the fish by providing a synthetic slime coat, reducing stress, and heals damaged tissue.
 - b. Note: to keep the gravel from being disturbed from the water entering the aquarium place a small plastic plate on top of the gravel and pour water slowly onto the plate. This will keep your plants and gravel in place.
7. Now we can plug in your electrical equipment. It is advised to allow everything to run for a period of time, perhaps overnight, to ensure all equipment is working properly. This will also give you aquarium heater time to bring the water up to the set temperature, as tap water is generally colder than needed for tropical fish. Be sure to set your timer for your lights to go on and off automatically.
8. Check your temperature to ensure you aquarium heater is set properly.
 - a. Add API QUICK START essential beneficial bacteria. This kick starts the biological filter aka the Nitrogen Cycle. QUICK START contains the bacteria that convert poisonous ammonia (fish waste) into nitrite (also harmful to fish) and then into nitrate. API QUICK START ensures your biological filter is established this process is called the nitrogen cycle, and it occurs in all underwater ecosystems. These bacteria continue to grow as your aquarium ages - living on the top layers of the aquarium substrate, decorations and filter media.
 - b. Feed the leaves - Add API LEAF ZONE as aquarium plants require sufficient amounts of iron and potassium to produce lush, green leaves. In a planted aquarium, however iron quickly become depleted, resulting in yellow decaying leaves and poor growth. Potassium is required by aquarium plants for photosynthesis and maintain cell pressure. API LEAF ZONE is a liquid fertilizer containing a special formula of chelated iron and potassium. Leaf Zone is readily absorbed through the leaves, supplying plants with essential nutrients. Regular use of LEAF ZONE keeps aquarium plants lush and colorful.
9. Now that your water is conditioned, your plants are positioned, and you are ready for fish, be sure to select fish that are plant-friendly. Whenever adding fish, protect them with API STRESS COAT.
 - a. Some fish are ideal to control algae. When selecting fish that are plant-friendly also consider fish that have a benefit. Fish such as *Otocinclus* is a genus of catfish that stay small and great at eating hair algae that can grow on your plants and decorations.

Routine Care and Maintenance

1. Whenever you are topping off your aquarium for evaporation or when you perform partial water exchanges be sure to use the "right" water. As most aquatic plants require water with a low to moderate hardness level be sure to test your water source or source RO/DI water.
2. Feed your fish twice a day when possible and only the amount they will consume within 3 minutes, always follow the feeding directions on the label. Feeding the correct nutritional content is essential to keep your fish healthy and active.
3. Add carbon in the planted aquarium. Aquatic plants require carbon to grow and thrive in the aquarium. Aquatic plants use carbon to fuel the photosynthetic process that turns light energy and nutrients into new plant growth. Carbon deficiency is one of the leading causes of poor plant growth in aquariums. API CO2 BOOSTER contains a unique organic carbon compound that aids plants for the uptake of essential carbon. CO2 BOOSTER counteracts carbon deficiency so plants can thrive and grow in the aquarium. CO2 BOOSTER can be used alone or with CO2 Injection. Add API CO2 BOOSTER daily.
4. Replenish essential nutrients - Dose API LEAF ZONE weekly and Add API ROOT TABS monthly for optimal plant growth.
5. Testing water is the best way to ensure your aquarium is in balance.
 - a. Over the first few weeks testing water every other day is a great way to learn about the nitrogen cycle. Record all test result and develop a chart to show the changes to water chemistry as the beneficial nitrifying in API QUICK START become established consuming the unwanted ammonia and nitrite from the aquarium.
6. Every 2 to 3 weeks perform a partial (20 to 25%) water change. Always remember to treat the water you are adding with API STRESS COAT. Routine water changes are the best way to prevent most problems that could occur. Routine water changes will help to decrease any accumulation of nitrate and phosphate over time.
7. Keeping your aquarium clean - Add API STRESS ZYME weekly to help keep your aquarium clean. Stress Zyme contains five different strains of beneficial bacillus bacteria that digest uneaten fish food, fish waste, decaying plant materials and other organic matter. The bacteria in STRESS ZYME specifically selected for their unique ability to consume organic matter that accumulates in aquarium.
8. Trim your plants as needed. Do not trim to soon! Let the plants grow and become established first. However, from time to time some plants will grow to large and can even overtake other plants and crowd them out. To keep your plants at the appropriate size and location it will be necessary to prune or trim them. Look up the specific plant species to understand the best method and care for each plant.

Questions

- Pass out the Questions worksheet (printable sheet included at the end of the lesson) to
- each student/family member.
- Review the answers to the questions during the discussion section of the lesson.

Discussion

- After finishing the items above including the questions and key terms, engage students/family members in a brief discussion about the lesson: What kinds of fish do we have in the aquarium?
 - Show students pictures of fish varieties that are not plant friendly.
 - How do plants reproduce in the aquarium?
 - Why are nutrients important to plants?
 - Why are bacteria important?

Quiz

- Once you've finished the discussion, pass out the Quiz worksheet (printable sheet included at the end of the lesson) to each student/family member.
 - Have them complete the quiz and then review the answers/have an open discussion about the answers with them. Answers are below.
1. Describe your favorite plant in our aquarium and how much light does it need?
 - See the appendix for a list of plants and their light demand (low, medium, high).
 2. Why can we not just add tap water to an aquarium without treating it. What are we treating it for?
 - Tap water contains disinfectants such as chlorine and chloramines and heavy metals. When treating with API Stress Coat these concerns are instantly taken care of and the tap water is safe for the aquarium.
 3. How many gallons is our aquarium and how much does it weigh?
 - Once you measure the size of your aquarium in inches and multiply the numbers then divide that total by 231 you will obtain the gallons of water. Multiple the gallons by 8.3 and you will have the weight of your aquarium.
 4. Name some essential nutrients that plants need.
 - Iron, Potassium, and Nitrogen
 5. How do plants absorb the nutrients they need?
 - Through their roots and leaves
 6. Why do we select "plant safe" fish, describe the concern with fish that are not plant-friendly?
 - If fish chew on the plants or dig excessively the plants will not be able to grow. A plant friendly fish is a fish that does not dig or chew on plants.

Additional Support Information

1. **How big is the aquarium?** If you bought it new the packaging would have indicated the size. It is important to know the size of your aquarium to know how much to of any product to treat with or when determining gallons when performing a partial water change during routine maintenance.
 - o One gallon of water contains 231 cubic inches. If you measure your aquarium in length, width and height in inches then multiply then the divide by 231 you get an answer in gallons. An example is a standard 15-gallon aquarium measure 12" x 12" x 24". When you multiply these numbers, you will get 3,456 then when you divide this number by 231 you will get 14.34 gallons. So now you can see the average 15-gallon aquarium holds 14.34 gallons.
2. **Decorations are not just for you to look at!** Decorations in an aquarium should serve a benefit for the type of fish being kept. Some fish naturally like to hide in plants or under rocks. Some will be very active, and others will seem to lie around. Some fish are naturally active at night while others will be out during the day. Each type of fish has habits that are unique to their type of fish. When you first enter fish into any aquarium they are stressed and will need time to acclimate. Providing them with different decorations to meet their specific needs helps them to adjust to their new home.
3. **The Nitrogen Cycle is important.** The fish produce waste from their gills and fecal matter in the form of ammonia. A chemist would write ammonia as NH_3 , that is nitrogen and hydrogen. The beneficial nitrifying bacteria consume/converts the ammonia from NH_3 to NO_2 this is called nitrite. Both ammonia and nitrite are bad/toxic for fish. In nature another beneficial nitrifying bacteria consumes/converts the NO_2 (nitrite) to NO_3 (nitrate). Nitrate is safe but not in large amounts. When you make routine water changes the nitrate is diluted.

The chemical process from NH_3 to NO_2 to NO_3 is called the nitrogen cycle. To determine the success of your nitrogen cycle, test your water using the API Master Test Kit. Add API Quick Start provide the nitrifying bacteria important for nitrogen cycle. As the fish produce more waste more bacteria are needed to maintain the proper balance. Over the first few weeks after setting up your aquarium the nitrogen cycle is becoming established. When the ammonia and nitrite remain at zero your nitrogen cycle is considered established and functioning properly.

4. **Algae is expected in any aquarium.** Algae is not harmful in aquariums, but it is not always something we may want to see as it takes from the serene setting. Algae attaches to the glass, rocks, gravel and decorations. If you scrap it away from the glass, you can then remove it. You can buy fish that will eat it, *Otocinclus* catfish another smaller algae-eating fish. You can also buy algae removing water treatment such as API ALGAEFIX™. API ALGAEFIX is a plant safe algacide.
5. **Fish need a balanced and complete diet.** In nature fish eat whenever they are hungry and often rely on eating live food. Things change when they are kept in aquarium setting. Fish need the some of the same things we do proteins, carbohydrate, vitamins, minerals and fats. Providing these in the correct balance is important because feeding too little is bad for them and feed to much will pollute their environment. API Fish Food have been formulated to provide your fish with all the ingredients fish need in the correct balance.

Feed your fish once or twice a day that amount they will consume in a few minutes. The food should be completely eaten. Over feeding will cause cloudy water and produce more ammonia in the water. Any food that is not eaten that is left over decays on the bottom and pollutes the water even more. Feeding is a good time to check your fish. Watch them carefully to make everyone is eating. Observe them to assure their fins and body are in proper condition. Observe their behaviors and colors.

6. **Choosing fish for a planted aquarium.** Many fish have a selected area that they prefer to stay in, the upper region, mid region or bottom region of the aquarium. Fish such as the hatchet fish, danios, Congo Tetras, Rasboras, Platies are fish types that swim higher in the aquarium. Fish such as gold barbs, glow-light tetras, rummy-nose tetras, neon tetra are example that stay in mid water of the aquarium. And fish such as *Corydoras* catfish, *Otocinclus*, *kribensis*, dwarf ram cichlids are fish that primarily stay on the bottom.

KEY TERMS

dGH

deutsch General Hardness, the measurement of calcium and magnesium ions

dKH

deutsch Carbonate Hardness also known as Alkalinity, the buffering capacity of the water. KH is the measurement of carbonate and bicarbonate ions

PHOTOSYNTHESIS

the process which plant use sunlight and nutrients to grow

pH

a measure of acidity of a solution. pH is the measure of the hydrogen ion (H⁺) activity of a solution

NUTRITION

the process of providing or obtaining the food/nutrients for health and healthy growth. Plants and animals including fish require the proper nutrition to grow and maintain their health. Animals need food in the forms such as proteins, carbohydrates, lipids or fats. Plants need sunlight along with nutrients such as iron, potassium, and carbon for proper nutrition.

QUESTIONS

1. Name each type of plant in the aquarium.
 - a. How big will each type of plant grow to?
 - b. How much light does each desired plant type need?
2. Identify the region of the world the plants in the aquarium are found.
3. What fish are plant-friendly?
4. Why is the size of gravel/substrate important for plants?
5. Why do plants need light?

QUIZ

1. Describe your favorite plant in our aquarium and how much light does it need?
2. Why can we not just add tap water to an aquarium without treating it. What are we treating it for?
3. How many gallons (or litres) is our aquarium and how much does it weigh?
4. Name some essential nutrients that plants need.
5. How do plants absorb the nutrients they need?
6. Why do we select "plant safe" fish, describe the concern with fish that are not plant friendly.

TYPES OF PLANTS

Low light plants

- Anubias barteri
 - Bolbitis heudelotii
 - Ceratophyllum demersum
 - Cladophora aegagropila
 - Crinum natans
 - Cryptocoryne aponogetifolia
 - C. beckettii
 - C. cordata
 - C. crispata var. balansae
 - C. undulata
 - C. wendtii
 - Echinodorus bleheri
 - Echinodorus 'Ozelot'
 - Hydrocotyle leucocephala
 - Microsorium pteropus
 - Nymphoides aquatica
 - Sagittaria platyphylla
 - Sagittaria subulate
 - Spathiphyllum wallisii
 - Vallisneria Americana
 - Vallisneria spiralis
 - Vesicularia dubyana
- Anubias barteri
 - Bolbitis
 - Hornwort
 - Algae Ball
 - African Onion Plant

 - Water Trumpet, Beckett's Crypt
 - Giant Cryptocoryne

 - Undulate Cryptocoryne

 - Broadleaved Amazon swordplant
 - Ozelot sword
 - Brazilian Pennywort
 - Java Fern
 - Banana Plant
 - Giant Sagittaria
 - Nettle Sagittaria, Floating Arrowhead
 - Peace lily
 - Dward Val, Eel grass. Jungle Val
 - Corkscrew vallisneria
 - Christmas Tree Moss

Medium Light Plants

- Acorus gramineus var. gramineus
 - Alternanthera reineckii "roseafolia"
 - Anacharis elodea
 - Aponogeton biovinianus
 - Aponogeton crispus
 - Bacopa caroliniana
 - Bacopa monnieri
 - Cabomba caroliniana
 - Cardamine lyrata
 - Ceratopteris cornuta
 - Ceratopteris thalictroides
 - Crinum thaianum
 - Cryptocoryne albida
- Crinkled or ruffled apoogeton

 - Dwarf Bacopa, Baby tears
 - Green Cabomba
 - Chinese Ivy, Japanese cress
 - Floating Fern
 - Water Sprite
 - Water Onion, Onion Plant

- *Cryptocoryne parva* Tiny Cryptocoryne
- *Echinodorus x barthii*
- *Echinodorus cordifolius* "Ovalis"
- *Echinodorus cordifolius* "Tropical Queen"
- *Echinodorus martii* (major) Ruffled Amazon swordplant
- *Echinodorus* 'Ozelot' Ozelot swordplant
- *Echinodorus* 'Rose' Rose swordplant
- *Echniodorus* 'Rubin' Rubin swordplant
- *Hygrophila corymbosa* Giant hydrophila
- *Hygrophila difformis* Water wisteria
- *Ludwigia repens* Creeping ludwigia, Narrow-leaf ludwigia
- *Polygonum spec.*
- *Ranunculus limosella*
- *Rotala rotundifolia* Dwarf rotala

High Light Plants

- *Alternanthera reineckii* "lilacina"
- *Aponogeton madagascariensis* Madagascar Lace, Laceleaf
- *Aponogeton rigidifolius*
- *Cabomba furcate* (piahyensis)
- *Crinum calamistratum*
- *Didiplis diandra* Water hedge
- *Echinodorus grandifloras* ssp. Aureus Large flowered Amazon swordplant
- *Echinodorus* 'Oriental' Oriental swordplant
- *Echinodorus schlueteri*
- *Echinodorus subalatus*
- *Eichhornia azurea*
- *Glossostigma elatinoides*
- *Hottonia palustris*
- *Hydrocotyle sibthorpioides* "Maritima"
- *Hygrophila guianensis* Guiana hygrophila
- *Hygrophila polysperma* Dwarf hygrophila
- *Lilaeopsis braziliensis*
- *Limnophila aquatica* Giant ambulia
- *Llmnophila aromatica*
- *Ludwigia arcuate*
- *Ludwigia helminthorrhiza*
- *Micranthemum umbrosum* Helzine
- *Myriophyllum aquaticum* (green) milfoil
- *Myriophyllum tuberculatum* (red) red myriophyllum
- *Rotala macrandra* Giant red rotala
- *Saururus cernuus* Lizard's tail

CONTACT US & ADDITIONAL RESOURCES

For more information regarding this lesson plan, API® brand, or any general fishkeeping questions and/or comments, feel free to contact us below.

- Website: <https://apifishcare.com/>
- Telephone Number: 1-800-847-0659