Water Gardening:

Biological Balance

K-STATE Kansas State University Research and Extension

Creating a healthy ecosystem in the pond is essential for clear water and healthy plant and fish life. Often considered a nuisance, algae are an important aspect of a balanced water garden. A patina of attached algae typically forms on pond sides after several weeks. It helps reduce green water algae common in ponds going through the start-up phase. Water lilies and floating leaf plants also help clear the water by shading the surface and limiting sunlight penetration.

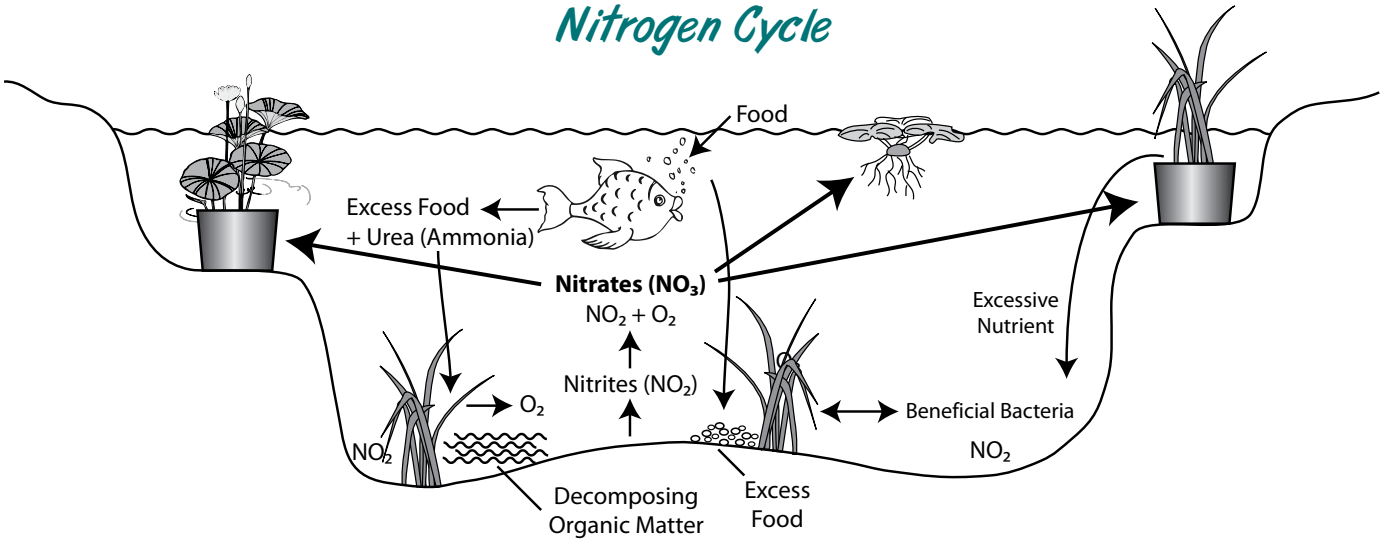
As the pond matures, all kinds of small aquatic organisms colonize on submerged surfaces. Beneficial bacteria, protozoa, and other invertebrates break down organic wastes caused by fish, plants, and other debris that enters the pond. During this basic biological process — the nitrogen cycle — bacteria convert toxic ammonia and nitrites into nontoxic nitrate. Resulting nitrates are used by plants, including algae, as food via photosynthesis. This is commonly called biofiltration.

Photosynthesis is another natural process that uses sunlight, nutrients, and carbon dioxide to grow plant tissue and produce oxygen. Plants and algae both depend on photo-synthesis for plant life. Plants are nature's No. 1 filtering system. They absorb toxins and excess nutrients, produce oxygen for fish, provide surface area for beneficial microscopic organisms, and shade the water surface. Mechanical filters filled with plastic string, lava rock, or mesh also can be used to create surface area for beneficial bacteria to colonize, filtering the water as it passes through. Plant competition for nutrients ultimately starves green water algae.

Achieving proper balance involves stocking and maintaining the pond in proportions that keep plants and nutrients ecologically balanced and help control algae. This may involve testing and treating water for basic water quality parameters. Here are a few simple steps to get started.

Use dechlorinator before adding life to the pond. City water and well water contain chemicals that are toxic to fish and aquatic microorganisms. New ponds should be treated for the

Nitrogen Cycle



Leaves, debris, and waste form Nitrites (NO_2). Plants give off Oxygen (O_2). Nitrites combine with Oxygen to Form Nitrates (NO_3). Nitrates are used by the plants and help to clear the water.

Calculate Pond Volume and Surface Area

Pond Shape	Approximate Gallons	Approximate Square Footage of Surface Area
Square or Rectangle	Length x Width x Depth x 7.5	Length x Width
Oval, Kidney, or Odd Shape	Length x Width x Depth x 6.7	3.14 (½ Length x Width)
Round	Diam. x Diam. x Depth x 5.9	3.14 (½ Diam. x ½ Diam.)

Measurements in feet.

entire volume to neutralize chlorine, chloramines, ammonia, and heavy metals. Once established, treat only for the amount of new water added.

Test and adjust carbonate hardness (KH) and acidity (pH) as needed to make sure basic water quality is within the range for a healthy pond. (See table, page 3).

Add plants. Aim to achieve 50 to 75 percent coverage of the water surface. More plants are needed in small ponds (under 1,000 gallons) and less for larger ponds. More plants will be needed for sunny locations and fewer for shade.

Water lilies, lily-like aquatics, and floating plants shade the surface and keep water cool. Shading reduces algae photosynthesis, and suspended roots of floating plants compete with algae for available nutrients. Lilies prefer still water and at least six hours of sunlight per day to bloom.

Submerged aquatics are underwater grasses that also compete with algae for carbon dioxide and dissolved nutrients. They serve as a spawning bed for fish and frogs while providing protection for smaller species. Use one bunch of submerged aquatics for every 1 to 2 feet of pond surface. These bunches can be grouped together in pots or planted directly in gravel beds, creating underwater groves. They do best when placed near moving water, for example under waterfalls, where they efficiently filter water.

Add fish. It is best to add fish after plants so they have hiding places. Fish eat pests and help circulate water. They also consume algae. Choose species that are compatible with water plants, keeping less than 1 inch of fish per square foot of pond surface area. See more on fish below.

Add beneficial bacteria to reduce green water periods and minimize sludge buildup on pond bottoms. Regular use keeps ponds cleaner, clearer, and facilitates filtration systems. Bacteria break down pond debris and reduce green water. Beneficial bacteria can be purchased and added to the pond. Follow manufacturer's recommendations.

Add barley products. Barley adds humic acid (a natural buffer) and as it breaks down, it releases compounds that retard algae growth. Barley typically is available in small bales, pellets, and/or liquid extracts. Barley is one of the most common water conditioners used by pond keepers. It is particularly helpful in ponds with shallow, sunny streambeds and waterfalls prone to growing large amounts of string or filamentous algae.

Adding a filtering system will improve water quality by removing debris and increasing growth of beneficial bacteria.

Above is a handy table for calculating pond volume and surface area. Use feet, not inches.

Stocking Fish and Scavengers

American goldfish, sarassa comets, and shubunkins are practical choices for the water garden. They are compatible with plants, eat pests, are fast enough to get away from most predators, and easily trained to eat out of your hand.

Koi are a popular and colorful fish. They grow fast, live long, and are more

Sodium Bicarbonate* Needed to Raise Carbonate Hardness

Pond size	10ppm	30ppm	50ppm	75ppm
100 gallons	0.24 oz	0.7 oz	1.2 oz	1.8 oz
250 gallons	0.6 oz	1.8 oz	3 oz	4.5 oz
500 gallons	1.2 oz	3.6 oz	6 oz	9 oz
1000 gallons	2.4 oz	7.2 oz	12 oz	18 oz
10,000 gallons	1.5 lbs	4.5 lbs	7.5 lbs	11.2 lbs

*Baking Soda

aggressive than goldfish. Koi love to burrow, eat, and uproot potted plants. Plants will need to be protected or kept separated from the fish. Deeper water allows fish to exercise and accommodates more filtration and aeration equipment.

It is not a good idea to add scavengers like snails or freshwater clams. Although they can be helpful to the ecosystem, these bottom dwellers can be a host to parasites that endanger fish health.

Sodium Bisulfate Needed to Lower pH

Pond size	With fish	Without fish
100 gallons	0.15 oz	0.75 oz
250 gallons	0.38 oz	1.9 oz
500 gallons	0.75 oz	3.75 oz
1000 gallons	1.5 oz	7.5 oz
10,000 gallons	15 oz	75 oz

Carbonate Hardness and pH

Carbonate hardness (KH) is the buffering capacity of water and is interdependent with pH, the acidity of the water. The lower the pH number, the more acidic the water. The neutral point is 7. Water pH changes throughout the day. Photosynthesis and excess nutrients occurring during the day increase pH and encourage algae. Respiration at night decreases pH. High pH can stress fish, inhibit plant growth, and curb the function of beneficial bacteria and microorganisms, causing more algae.

Carbonates buffer pH so there is less fluctuation. The ideal carbonate hardness is 90 to 180 parts per million, and the ideal pH is 6.8 to 8.2. There should be no more than 0.8 fluctuation of pH per day. Test kits are available to check the carbonate hardness and pH of the pond water and may be purchased at aquatic garden centers.

Plants and beneficial bacteria will deplete carbonates, so water should be retested monthly throughout the growing season. If carbonates are below 125 ppm (parts per million), sodium bicarbonate (baking soda) can be used to adjust. Once the KH is in range, pH can be adjusted. If pH is above 8.2, water can be adjusted by using sodium bisulfate or other safe acids like vinegar or muriatic acid. If the pH is too low (acidic), changing out 20 to 25 percent of the water will usually remedy the situation. Water in the Midwest tends to have a higher pH, being more alkaline.

Application rates to raise KH with sodium bicarbonate can be found in the table above. Retest after six hours and continue until readings are 125 to 180 ppm. *Note:* 1 tablespoon = 0.5 oz = 3 teaspoons.

To reduce pH, add sodium bisulfate and test morning and evening every day until readings are between 6.8 and 8.2. To minimize stress on fish, do not reduce more than 0.2 pH points per day. See table above. *Note:* 1 tablespoon = 0.75 oz = 3 teaspoons.

**Charts are used with permission from pond industry members Deb Spencer and Susan Davis.*

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