

## HELEN NASH'S 'BAKER'S DOZENS'

Helen Nash is the Editor of *Pond & Garden Magazine* and the author of The Pond Doctor, The Complete Pond Builder, Waterfalls, Fountains, Pools and Streams (Spring 2000 Alternate Selection of the Garden Book Club), Water Gardening in Containers, Low Maintenance Water Gardens, Water Gardening Basics, Plants For Water Gardens and The Living Pond, all published by Sterling Publishing Co. in New York. The tips in *Helen Nash's 'Baker's Dozens'* are taken, in part, from these publications.

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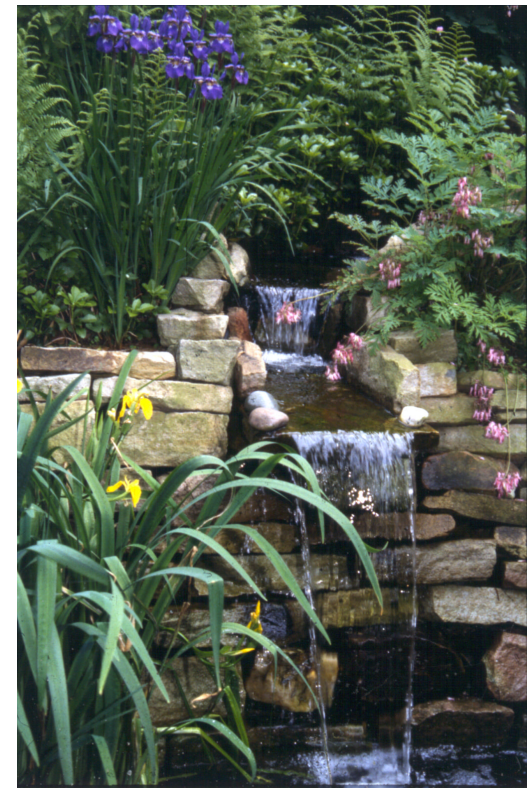
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## TIPS FOR SUCCESSFUL PONDKEEPING

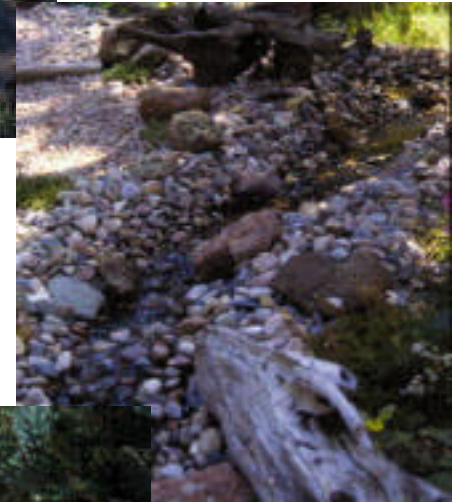
## HELEN NASH'S 'BAKER'S DOZENS'

### TIPS FOR SUCCESSFUL PONDKEEPING



Ask any pond owner what is the best part of having a backyard pond and you'll get the same answer from every one – the peace and tranquility!

Water gardening is the hottest gardening trend since the vegetable garden. No matter what climate zone you live in, including water in the landscape is doable. These tips are compiled from the experiences of gardeners just like you. We hope they will help you enjoy your pond even more!



Use a reservoir system to create a very shallow stream or flowing water feature. The reservoir will hold twice the water involved in the feature and is set up in the ground with a protective grate over it. The recycling pump is set in the bottom of the reservoir. Camouflage the grate with cobbles or rocks.

**BUILDING A CHILD-SAFE WATER FEATURE**



Build a shallow pond filled to the water's surface with rocks. You can use 'fillers' - pots or pieces of drainage tile - under the rocks to gain more water volume. Select attractive larger rocks for your focal point and set up a bubbling fountain, run by a submersible pump. You'll be able to grow nearly all aquatic plants except for surface floating plants such as water lilies. Simply tuck the potted plants among the rocks. Follow all electrical safety precautions. The same principle can be used with container gardens, using a grate or plastic form with a sump area, both fitted with spouting ornaments or fountains and the grate or sump holder camouflaged with rocks.

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## A DOZEN WATER GARDEN DESIGN TIPS

1. Decide what kind of pond you want. Most water lilies require 5 or more hours of direct sunlight. Koi require a minimum of 3 feet water depth, preferably 4 to 5 feet.
2. Site your water feature where you can enjoy it most. Being able to see it from inside the house is an extra bonus.
3. Consider predators. Raccoons will use shallow shelves to fish from. Herons will land in shallow water. Plants can be set at appropriate depths with pedestals or free-standing holders.
4. If you will use a shallow shelf design, make the shelf wide enough to hold potted plants. Added safety is gained when the shelf is wide enough to support a person.
5. Turf and landscaping can be brought up to the pond's edge with heavy-grade landscape edging. Simply drop the liner over the leveled edging and backfill with soil.
6. Siting near deciduous trees/shrubs or downwind of them means more maintenance.
7. If you have a waterfall, site it on the far side of your pond's viewing area.
8. If nearby trees have roots growing in the direction of the pond site, use chemically treated landscape fabric to create a wall between roots and pond.
9. Plan for low maintenance surrounds of your pond. Rock garden adaptations can be coordinated to the rest of the backyard scaping and tie the pond into its surrounds. The actual pond edge should be slightly elevated to prevent surface ground water from washing into the pond.
10. If you install shallow planting shelves in your pond, make them wide enough to support an adult. You'll be able to fit more plants onto them, and they'll act as a safety net in case someone falls in.
11. If you live in a freezing climate, provide temporary fencing around or plank boards across the pond during the winter to prevent pets, especially small breeds, from falling through thin ice.
12. If young children will be around your pond and you have a bridge crossing the water, choose a bridge design with safe railings. You may wish to also apply a non-skid surface to the bridge.
13. Keep child-size life jackets on hand for young guests. It only takes a second for a child to disappear from sight.



Fence your yard or your pond!



## A DOZEN POND SAFETY TIPS

1. Before you install a pond in your yard, especially if you live in an urban area, *fence your yard*.
2. Hire a professional electrician to bury the electrical conduit to the pond area.
3. Run all electrical appliances through a Ground Fault Circuit Interrupter (GFCI). These units will automatically shut off when dangerous conditions exist.
4. Avoid using outdoor extension cords to run electrical appliances/lights in the pond.
5. *Never* use indoor extension cords, even temporarily, outdoors.
6. If your fish are acting erratic – jumping, skittish swimming, etc. – shut off electricity to the pond before touching the water.
7. Stabilize all pond edging. Your pond will be the first place visitors go in your yard! Make sure any rocks around the pond can support an adult without tipping.
8. Make it part of your annual pond maintenance to check all mortared areas of the pond, especially around rock edgings, for deterioration and repair, if necessary.
9. Provide easy access to your pond. Very sloped sides may be difficult to navigate as they are slippery, as may be a two-foot-high step out of the pond. Even if you don't have a foot-deep planting shelf, you may wish to provide one area of the pond with such a 'stairstep.' *You will get into the pond on occasion!*
10. If the pond will hold more than 500 gallons of water and you might keep Koi or a large number of fish, include planning for filtration even if it will be installed later.
11. An elaborate or extensive pond design can be installed in stages. If one pond will eventually act as a reservoir pond for recycling water through a stream/waterfall system, be sure the reservoir pond will contain enough water so as not to be lowered significantly when the system is operating.
12. Low areas that collect water are not the best sites for backyard ponds.
13. Use a preform pond set within a raised planting bed for a small water feature. Even whiskey barrel-sized containers can be set within the ground and used as aquatic plant containers. Lotuses are especially nice in such containers as, even in a zone 5, the lotus plant will winter over in them outdoors when mulched heavily.



## A DOZEN WATER GARDEN CONSTRUCTION TIPS

1. Before you dig, check your water table. French drains may be necessary to avoid the liner floating up out of the excavation.
2. Use a good quality liner. Cheap doesn't mean much if the pond develops leaks and requires liner replacement. Roofing liner may be safe or it may not. If you keep expensive fish, it is best to pay for 'fish-safe' membrane. Check guarantees and warranties on materials. Plastics degrade quickly with UV rays. Fully line waterfalls and streams to prevent water loss. Leave enough excess liner to bury it into the surrounding soil in case of future ground settlement.
3. Loose stone can be used to line streams as the constantly flowing water over the rocks supplies ample oxygen for aerobic bacteria to process particulate wastes. Using stone in the bottom of the pond itself means considerable maintenance with an annual and thorough cleaning of the rocks being necessary to prevent sediment buildup (unseen) down in among the loose gravel or rocks. The unseen danger of such build-ups is that the organic debris collects under anaerobic conditions – there is no oxygen available for aerobic bacteria to process it. Instead, anaerobic bacteria go to work, their by-product being hydrogen sulfide which is deadly toxic to fish. Overnight you can lose all of the fish in the pond. A sign this is happening is the pond's acquiring a foul odor. A healthy pond does not smell badly!
4. Excavated soil can be used to build up a waterfall or stream area, but allow a full season to settle. Otherwise, tamp it well and soak it daily for a couple hours with a soaker hose for two weeks.
5. Give extra support to the ground around the pond's edge if heavy rocks are used. Mix dry concrete into the soil under them to help stabilize the construction.

provide a start for the one you will use indoors. Check the temperature of the pond and their new quarters before moving them. You'll want the temperatures about equal. If they are more than 2 degrees apart, you'll have to float the fish in bags of pond water until the temperatures are equalized before releasing the fish in their new quarters.

- 13 Check your fish stocking level before you go into winter. If the pond is maximally stocked with fish, providing a clean winter pond and supplemental oxygen in the top third of the pond may be necessary. You may still decide to winter the smallest fish indoors.

## CONTAINER GARDENING TIPS

1. Terra cotta and other porous containers should be fully sealed on the inside with a poly sealer. Allow each of 2 or 3 coats to dry between application.
2. If your container offers at least 3 to 4 inches over the plant's crown, you can grow dwarf-type water lilies. The very pale blue 'Dauben' is an excellent tropical lily choice. The yellow pygmy 'Helvola' is a recommended hardy selection.
3. If you don't have a small fish or two in your container to eat mosquito larvae, control the larvae with *Bacillus thuringiensis (Bt)* that comes in a floating doughnut shape. The little doughnuts can be broken in half or crumbled if your container is small.
4. In whiskey barrel-sized containers, keeping a few bunches of submerged grasses will help keep the water clear. Smaller containers resort easily to regular water changes.
5. In cold climates, either move your container indoors for winter or dismantle it and store your plants elsewhere, moving any fish into an indoor aquarium.

7. Many koi keepers salt their winter pond water to protect their fish in cold temperatures that cause the fish's immune system to shut down. Do not salt water in which you have aquatic plants. Remove plants and store elsewhere if you will salt the pond.
8. Remove all tropical plants, particularly water hyacinths and water lettuce, when the first frost hits. They will quickly begin to rot and foul the water.
9. Move tropical marginal aquatics indoors before the first frost tells them to shut down and die. Treat them as houseplants, removing fertilizer for a few weeks' rest, and providing 12 to 14 hours of daylight. (You'll probably supplement with grow-lights.)
10. Tropical water lilies may be treated as annuals and simply discarded. If you wish to winter them over, allow them to experience two hard frosts before removing them from the pond. Let the pots dry out for two days in temperatures no lower than 50 degrees. Rinse soil from the plant and find the hardened tubers around the mother plant. Daybloomers will have the nutlike tubers around the base of the rhizome; nightbloomers will have them embedded within the mother plant. Allow the tubers to dry for a day or two and then store in barely damp sand or in distilled water in airtight containers at 50 to 55 degrees. Refrigerator bin-storage is slightly too cold and results in some of the tubers not making it past January. Check tubers periodically to be sure they are still firm and, in the case of sand-stored tubers, still damp.
11. As the weather cools in early autumn, switch to wheat germ-based food for your fish to fatten them up for winter hibernation. Cut back on the amount fed and stop feeding altogether when the water temperature stabilizes below 50 degrees. You will not feed them again until the spring water stabilizes above 50 degrees.
12. If you will winter your fish indoors, prepare their quarters a good month before moving them inside. Use your outside bio-filter to

6. Make sure the pond's top edge is level to avoid the pond looking lop-sided.
7. Pad the liner where heavy rocks or structures are placed. Use several pieces of scrap liner or sheet Styrofoam. Fully underline the pond liner to prevent puncture by rocks working their way up through the ground.
8. Fill in behind waterfall rocks with spray poly foam to prevent water loss.
9. Do not piece the pond liner itself. Waterfall or stream liner sections may be overlapped at points of elevation changes, the higher piece overlapping the lower so that the overlap does not occur under water.
10. Streams need have only one inch per 10 feet variation to effect flow.
11. If a child-safe water feature is necessary, consider reservoir construction with a shallow stream, millstone, or flowing fountain type feature.
12. If you'd like an extensive pond and stream design in your yard, plan it in stages to be executed over a period of time. For example, start out with one pond that will be used as the header pond for the stream and larger pond to be constructed in the next year.
13. Do not buy your pump until you've finished the pond. That way, you can be sure to have the right size for your design. Plan on 100 gallons per hour for each inch of spillway (or stream width). You'll need to know how high the uppermost point of waterflow is, too, so that you can consult a pump chart for the correct flow at that height or lift.

## A DOZEN POND LANDSCAPING TIPS

1. Low maintenance is the key to pond enjoyment. Consider using stone, decking, or mulch surrounds. To prevent weeds from growing through, create a base of geo-thermal fabric covered with stone and sand. Fabrics allow water to pass through, preventing puddling.
2. Select specimen plants that enhance poolside reflections – ornamental grasses, for example.
3. Avoid planting plants that shed petals and leaves that make for greater pond maintenance.
4. Avoid plants with toxic leaves that might impact your fish.
5. Avoid planting pines, maple, and oak trees nearby as their leaves give off tannic acid in the water, discoloring the water and possibly affecting your fish.
6. If you use stone to edge your pond, extend the stone out into the landscape to ‘anchor’ the pond into its setting.
7. A lattice-topped pergola allows enough sunlight to grow aquatic plants and helps protect your pond fish from overhead predators like herons and egrets.
8. If you would include a bridge in your design, keep it in proportion to the water feature. Even if the bridge will not be used, set it up to look functional – i.e., crossing a span of water where one might actually wish to cross.
9. Consider garden lighting to extend the hours of pond enjoyment. Soft low-voltage lighting tucked among the surrounding plants creates ambiance with nighttime reflections. Cross-light a waterfall or uplight a fountain.

## A DOZEN WINTERIZING TIPS

1. Net your pond before autumn leaves begin to fall. Allowing leaves to accumulate in your pond can produce unsightly tannic acid (brown water!) and foul, smelly water as the leaves quickly begin to decompose. The by-product of that decomposition is fish-toxic hydrogen sulfide.
2. In your fall cleaning, remove accumulations of mulm and debris from the pond bottom. This can be done with a swimming pool skimmer net or with a pond vac. Executing a 25% water exchange at this time may freshen the water for winter. Be sure to use dechlorinator, if necessary.
3. When the water temperature stabilizes around fifty degrees, remove your submersible pump, clean it, and store for the winter. Do not run waterfalls through freezing weather – ice sculptures can camouflage water loss!
4. Store oil-encapsulated submersible pumps in a bucket of water to prevent their seals from drying out. (They can also be ‘stored’ on the pond bottom, not running, where they will not freeze.) Store mag-drive pumps dry.
5. If you will run your pump simply bubbling at the pond’s surface to help keep a hole open in the ice, move the pump into the top one-third of the pond’s depth. Running a pump from the pond’s bottom allows colder surface water to mix with the slightly warmer water below, jeopardizing your fish.
6. Use a floating stock-tank heater or de-icer to keep a hole open in freezing weather. Your pond should not be fully iced over for more than three days. The open hole allows gas exchanges, primarily a release of toxic gases.



9. Computing volume of concrete:

For squares and rectangles, multiply the thickness in inches by the length by the width and divide by 12 to get the number of cubic feet. Divide that by 27 to get the number of cubic yards.

For circles, multiply the thickness in inches by 3.14 by the radius squared and divide by 12 to get the number of cubic feet. Divide that by 27 to get the number of cubic yards needed.

10. Recommended tubing bore for pumps to waterfalls:

_ inch diameter	for flows up to	120 pH
_ inch diameter	for flows up to	350 pH
1 inch diameter	for flows up to	1000 pH
1 _ inch diameter	for flows up to	1500 pH
1 _ inch diameter	for flows up to	3000 pH

11. Converting metrics:

<u>To convert</u>	<u>Multiply by</u>	<u>To obtain</u>
inches	2.54	centimeters
inches	25.4	millimeters
feet	30	centimeters
pounds	0.45	kilograms
U.S. gallons	3.8	liters

12. To convert temperatures:

Fahrenheit to Celsius: Subtract 32, multiply by 5, and divide by 9.

Celsius to Fahrenheit: Multiply by 9, divide by 5, and add 32.

10. Container plants can adorn your pond's perimeter. Consider using aquatic plants, too, in these pots.

11. Spouting statuary can recycle water from the pond into delightful garden décor on the pond's edge...or even within the pond.

12. Keep the plants in the foreground of your view of the pond on the low side. Use taller plants on the far side of the pond.

13. Rocks used to anchor the pond should be set with one-third of the rock within the ground.



## A DOZEN AQUATIC PLANT TIPS

1. The traditional eco-balance formula is a valid, plant stocking guideline, but it is not mandatory. The key to clear water is keeping your fish load below maximum level and supplying enough submerged or floating aquatics to use pond nutrients.
2. Submerged aquatic plants are considered delectable salads by most fish. Large fish may make it impossible to keep them! In the presence of large fish, include a separate pond/area for fish-tasty plants.
3. Submerged plants are often called 'oxygenating' plants, but remember that at night, they use oxygen in respiration.
4. Planting in pots with or without holes is a personal preference.
5. The best soil for aquatic plants is clay-heavy garden loam. Do not use planting mixes that include peat or vermiculite as the lighter weight additives will float into your pond water. Don't be afraid to experiment. Many aquatic plants can be grown hydroponically or in gravel, without any soil at all.
6. Aquatic plants should be fertilized for maximum growth, especially if you are using soilless media or if the plants have been in the same soil for more than one season. Do not use fertilizer with more than 10 percent nitrogen. Extended release fertilizers are now available that reduce the frequency of fertilizing.
7. Most aquatic plants need to be divided each year. Spring bloomers and early summer bloomers are divided after their bloom season. Plants may be divided into mid to late summer, so long as the roots have enough time to establish before the plants go dormant.

## 7. Figuring building supplies:

Crushed limestone (hardcore) is sold by the ton, and is also known as #53. One ton is approximately 20 cubic feet.  
 Flagstone, slate and flat granite are sold by the ton. North Carolina Granite, Tennessee, and Lannon Regular cover 70 to 80 sq. feet per ton. (1/4 inch to 2 \_ inches thick)  
 Lannon Select and Cherokee Marble cover about 100 sq. feet per ton.  
 Pennsylvania and Vermont Slate cover 150 to 170 sq. feet per ton.  
 Featherock weighs approximately 64 pounds per cubic foot.  
 Granite weighs approximately 200 pounds per cubic foot.  
 Brick is figured at 4.5 bricks per square foot, laid flat.  
 Cement and mortar, sold by the 80-pound bag, premixed, will fill 2 square feet at a 4 inch depth.  
 Cobbles are round stones, usually fitting in two open hands with 30 to 35 per ton.

## 8. Pump Sizing Chart:

Lifts	1'	3'	5'	10'	15'	20'
GPH	120	70				
	170	140	100			
	205	168	120			
	300	255	205	70		
	325	300	270	130		
	500	435	337	210	65	
	600	580	517	414	230	90
	710	690	670	580	380	150
	810	790	745	613	415	173
	1200	1170	1100	1000	840	520
1/6HP				900	690	480
0.3HP				2750	1750	750
0.4HP				3250	2500	1550

## A DOZEN POND MATH FORMULAE

### 1. Computing Flexible Liner Requirements:

Maximum length + (2 times max depth) = total length of liner  
Maximum width + (2 times max depth) = total width of liner  
Add 6 inches all around for overlap.

### 2. Computing pond volume in gallons:

Length x width x depth x 7.5  
For a round pond;  $r \times 3.14 \times \text{depth} \times 7.5$

### 3. Computing surface area of pond:

Square or rectangular shape; multiply length x width.  
Circular shape; multiply  $3.14 \times \text{radius squared}$  (half diameter).

### 4. Richard Schuck's Ten Percent Solution (Natural, vegetative filtration):

Surface area of biofilter and natural filter = 10% of pond's surface area  
Water flow per hour = \_ to \_ of pond volume  
Depth of natural filter = 10 to 18 inches

### 5. Figuring size of pump:

100 gallons per one inch of spillway or stream width, figure highest point water must be pumped, find that height on pump chart to get the desired amount of flow.

### 6. Figuring size of pump for spouting ornament or fountain:

Figure height of statue, multiply by 1.5. Use pump chart and find shut-off column. Find size of pump that shuts off at the height you determined.

8. Hardy aquatics can be left in the pond year-round. Hardy water lilies should be set into the deepest part of the pond in winter to avoid their rhizome's freezing. Hardy marginal plants can be left in place through the winter. Most tropical aquatic plants can be wintered indoors as houseplants, however, stop fertilizing them so that they can rest, too. Remember many tropical plants are day-dependent and will require supplemental lighting to extend their winter days.
9. Thin rampant growers such as water hyacinths, floating heart, and azolla since their surface coverage prevents the pond water from accessing its most important source of oxygen.
10. Rinse new plants well before adding them to the pond. Even small pieces of string algae can infect your pond. Parasite eggs can be removed; check leaf undersides.
11. Stocking your pond with plants taken from the wild can introduce parasites to your pond. Be sure you purchase nursery-grown stock.
12. Plant taller aquatics in wide-mouthed pots to prevent their tipping over. Top your potted aquatics with gravel to prevent soil from murking up your water. Use rocks as large as your fishes' noses – or use flat rocks that are more difficult for the fish to move about.
13. Consider terrestrial plants that adapt to water culture – daylilies, for example. Cannas, polka dot plant, and calla lilies are others.



## A DOZEN FISH KEEPING TIPS

1. The typical water garden of 2 to 2.5 feet depth is best stocked with goldfish. Koi, including butterfly or long-finned koi, require at least 3 feet of depth. Generally, consider your pond's stocking capacity to be one inch of goldfish, or one-half inch of Koi, per square foot of exposed water surface. (This is based on the fact that the primary source of oxygen in your pond water is at the water's surface where it touches the air.) Once your pond nears its maximum stocking level, bio-filtration is necessary.
2. Do not purchase fish if other fish in the tank are sick. Sick fish may have dull eyes, inflamed skin, frayed fins, or isolate themselves from the rest of the fish in the tank. Both goldfish and Koi are sociable, schooling fish.
3. Any new fish to be added to the pond should be kept in a separate quarantine tank for at least 7 to 10 days for observation of any health problems.
4. Snails are the intermediary host for anchor worm. If you have snails in your pond, check fish in the early spring and in the autumn for this parasite.
5. Fish in a newly installed pond should be fed; the normal food chain requires time to establish.
6. Feed fish only what they will eat in 5 to 10 minutes. Floating fish food assures you that food does not end up on the pond bottom where it will decompose and foul the water. For easy monitoring of food-consumption, you can train your fish to eat from within a floating ring in which you deposit their food ration.
7. Fish need high protein food in the summer. In the spring and autumn, feed them wheat-germ based foods that are easier for their slowed metabolisms to digest. Do not feed fish when the water temperature is below fifty degrees or above ninety degrees. (This includes brief warm spells in the winter.)
6. Every spring check any mortared areas of your construction. In climates where freezing occurs, you may have to repair cracked and loose areas.
7. Regardless of your area, plan a major pond cleaning once a year. In northern climates, this is best done in the autumn to prevent sediment from decomposing and contaminating the water over the winter. If you've kept the pond bottom clean, a major cleaning may not be necessary for several years at a time. When you must fully clean out the pond, provide temporary quarters for your fish and lower the pond to effect the cleaning.
8. Rig a tented birdnet over the pond to prevent autumn leaves from accumulating in the pond.
9. Monitor filter media to be sure excess sediment doesn't collect. This sediment can impair the workings of the filter and the pump, as well as contribute to toxic water conditions.
10. If your area freezes during the winter, disconnect the waterfall to prevent water losses under 'ice sculptures.' If your winter water temperature drops below fifty degrees, move submersible pumps into the top one-third of the pond's water to prevent cooling of the lower waters where your fish will 'hibernate.'
11. Store submersible pumps in a bucket of water to prevent their seals from drying out and cracking. Magnetic drive pumps may be stored dry.
12. If string algae is a problem, shut off your pump and allow the waterfall to dry. Use a clean brush, untreated by soaps or chemicals, to scrub the waterfall area.
13. Use a swimming pool skimmer net to keep the pond's surface free of floating debris. These nets are also good for netting out debris on the pond bottom.

## A DOZEN POND MAINTENANCE TIPS

1. You can exchange five percent of your pond water each week without having to treat for chlorine. Spraying the fresh water onto the pond's surface flashes off the chlorine. If your public water supplier uses chloramines for a longer-lived disinfectant (call them to find out), they are adding ammonia to the water to bind with the chlorine. Test your tap water to determine the level of ammonia present in such water. You may have to treat new water additions for ammonia presence.
2. One way to freshen five-percent of your pond water is to perform the exchange in conjunction with a pond vac working a portion of the pond's bottom. A little bit performed each week results in a pond free of inordinate buildups of sedimentary material.
3. Because water lily leaves live only about three weeks during the summer, keep yellowing leaves pruned from your plants to avoid their decomposition and adding to the pond's bio-load. Prune away dying flowers and any other dying foliage.
4. Never drain your pond or top it off without monitoring the hose. If you must leave the pond unattended during these times, use a timer affixed to the hose spigot to prevent accidents.
5. Even in very hot weather, evaporation does not cause very significant changes in water level from one day to the next. (Streams, waterfalls, and fountains cause greater evaporation rates, however.) If you notice a significant drop in the water level, you may have a leak. Check all plumbing fixtures. Disconnect the waterfall and determine if the leak seems slowed. If the leak is in the waterfall area, check that the liner is above the water/splash level. Be sure any pieced liner used in a waterfall overlaps only at elevation changes so that the piecing is not actually submerged. If the leak is in the pond itself, prepare a bottle with food coloring or milk in it. Once the water level seems to have stabilized, squirt a bit of the colored water every few inches around the pond's edge. The colored water should shoot into the leak, locating it for you.
8. Check your pond for sharp-edged rocks that might injure the fish during spawning.
9. Treat injured or sick fish in a separate hospital tank. Often, a three percent salt solution in the hospital tank is enough to take care of the problem.
10. Fish need oxygen. They'll tell you when it's getting low in the pond: they gasp at the water's surface or congregate around waterfall entries. Aerate the pond with an air pump and a long bar stone dangling into the water. Check surface coverage of plants. Run your pump through the night when oxygen levels in your pond are at their lowest point.
11. Warm water holds less oxygen than cooler water. Watch for signs of low oxygen during hot summer weather. Because fish require more oxygen to digest food, this is why we don't feed our fish when the water temperature goes over ninety. Keep a thermometer submerged one-third of the way into the pond's water to monitor the temperature.
12. Larger fish will eat small tadpoles....and large frogs, such as green frogs, bullfrogs, and leopard frogs will eat small fish. If you hear frogs calling in your ponds at night, you may find their eggs floating on the water in the morning. Frogs lay their eggs in a mass of jelly while toads lay their eggs in strands of jelly, usually draped among the marginal aquatic plants around the pond's edge.
13. When water temperatures drop below fifty-five degrees, your fish lose much of their enzyme protection in their slime coats. Their resistance to parasites and disease is significantly lessened. Monitor them during these periods for signs of problems. Should problems occur, remove the fish to a hospital tank for treatment.



## A DOZEN WATER GARDEN FILTRATION TIPS

1. Mechanical filters prevent particulate debris from circulating through your pump (and burning up the pump). If you have to clean your mechanical filter more than once every few weeks, you need more surface area in the filter.
2. Biological filters enhance the nitrogen cycle in your pond, converting organic wastes into ammonia, then into nitrite, then into nitrate. They have nothing to do with water clarity. They deal only with water quality.
3. Beneficial aerobic bacteria can be used to jump-start your biofilter. This bacteria is not effective in water cooler than 50 degrees or warmer than 90 degrees. Such bacteria can be added to the pond water itself, even without the presence of a biofilter.
4. Anaerobic bacteria work to decompose organic wastes that are not in direct contact with oxygenated water. Their byproduct is fish-toxic hydrogen sulfide and methane gasses. For that reason, do not allow your filter media to become coated with thick layers of sediment.
5. Water garden biofilters can use several media – lava rock, bio-ribbon, bio-balls, even plastic bird netting.
6. Unless the pond is overstocked with fish, 10 percent of the pond's volume should be involved in the filtration system. An overstocked pond should include about 20 percent of the pond's volume in the filtration system.
7. Koi ponds require larger systems for maximum benefit to the fish. A bottom drain and an out-of-pond filtration system are usually recommended.
8. Natural filtration or vegetative filtration can be effective in the pond not overstocked with fish. An area equal to 10 percent of the pond's surface area is devoted to growing submerged and marginal aquatics with the water running through that area before returning to the pond. This ten percent area can be set up as a dual-pond system or as a marsh garden feeding the main pond.
9. Many pondkeepers use water celery or water hyacinth in the top of their bio-filters to provide extra plant filtration.
10. Swimming pool filters can be adapted to pond use, but they require adjustment in the media such as coarser gravel rather than the traditional sand. Such filters still require daily backwashing, a maintenance regime unacceptable to most water gardeners.
11. Traditional aquarium filter units are not used with outdoor ponds. Charcoal and ammo chips (zeolite) are too expensive to be used in the requisite quantity required by a pond. Zeolite may be used as an emergency treatment in the event of spiking ammonia in the pond, but it is more common to simply change 25 percent of the pond water and lessen the fish load in the pond.
12. A water test kit to test for ammonia and nitrite levels should be used once a month in the low fish-stocked pond. Use weekly in a maximally stocked pond. Also, monitor the water's pH. This is an indication of the amount of free hydrogen ions in the water. pH readings above neutral can amplify the presence of ammonia. Rather than adjusting pH, supply buffers to the water to prevent dangerous swings in the pH level of the water.
13. Ultraviolet clarifier lights are useful for controlling green water algae, especially in Koi ponds in which submerged or floating aquatics are not practically kept. Be sure your water flow past the light is appropriate, and replace the light bulbs once a year.