Introduction To Koi Ponds

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Koi Pond Basics

Koi can be successfully kept in a wide variety of ponds. When planning your pond, you should consider the following:

pond size
pond shape
water filtration
location on lot
plants in the pond
size and quantity of koi to be kept
pond construction
starting up your pond

Size: The size of your pond is the main factor that will determine how many koi you can keep. Size also plays a large role in water quality. Generally, the larger the better. With more water, changes in conditions will occur more slowly. The larger you make your pond, the better it will be able to accommodate your koi as they grow larger.

Shape: The shape of your pond is important. You want your pond to have a pleasing shape, but you must also consider water flow. Avoid shapes that will allow water to stagnate. Stagnant areas will collect debris which is a breeding ground for parasites and bacteria. If you have predators such as herons or raccoons, then having steep sides will be a deterrent since they need to be able to wade into the pond to go fishing. You should shape your pond so that you can get out of it. Sooner or later, you will need to get into your pond for maintenance or someone will fall in. You need to be able to get back out.

Filtration: Your filter performs two primary functions: removal of solid waste and decomposition of chemical waste. Solid waste is removed mechanically – the solids are physically trapped in the filter. Chemical waste (primarily ammonia) is decomposed through a biological process where bacteria convert ammonia into nitrite and then into nitrate. To support biological filtration you just need lots of surface area for bacteria to grow on.

There are dozens of types of filters available. Most work well with proper maintenance, but none will make up for poor pond keeping practices. Some of the important differences to look for between different types of filters are: size, maximum water flow rate, frequency of cleaning required, and ease of cleaning.

There are many materials used in pond filters and most will perform mechanical and biological filtration. Materials commonly used are: lava rock, gravel, filter matting (similar to furnace air filter material), brushes (similar to chimney sweeping brushes), bio-balls (look like pin cushions), and plastic beads.

UV (ultra violet) filters are commonly used on koi ponds. They are used to control algae. The UV basically sunburns the algae to death.

Your pond's entire volume of water should pass through the filter once every one to two hours. Your water should return to the pond via a stream or waterfall to provide aeration.

Location on lot: Locate your pond where it can be seen from the house – you'll get more enjoyment from your pond if you can watch it while eating breakfast or relaxing in your easy chair. If your pond is in the far corner of your yard, you may be likely to ignore it and not notice if problems occur. Avoid locations that will collect leaves. Make sure that run off water does not go into your pond – fertilizers can kill your koi.

Plants in the pond: Plants can be good or bad. On the good side, plants will consume some of the waste products, they provide shade for the koi, and they look nice. On the bad side, you koi will tend to dig in the pots and eat the plants. If you have plants, put large smooth rocks in the planter to keep the koi from digging. The best way to combine plants and koi is to provide a separate area for the plants (such as along your stream or in a small pool at the head of your stream).

Size and quantity of koi: A common mistake (by experienced koi keepers as well as novices) is to over crowd their pond with too many koi. The more koi you have in your pond, the more waste they produce and the quicker small problems become big problems. A good rule of thumb is to limit your pond to 4 oz. to 1 lb. of koi per 100 gallons of water. The chart below shows approximate weight vs size for average build koi. Lengths are from tip of nose to tip of tail. Allow for your koi to grow. Average lengths of koi are: 1 year old - 6" to 8", 2 year - 8" to 10", 3 year - 12" to 16". Growth rates can vary drastically.

Length (inches)	Weight (ounces)
6"	1.5
8"	3.6
10"	7
12"	12
14"	19
16"	28

Pond construction: The most common materials for ponds is concrete and EPDM (rubber) liners - both work fine, but neither is perfect. Include a bottom drain in your pond - this will get debris to the filter as quickly as possible. Include a skimmer - this will collect dust and leaves before they sink to the bottom and rot. Use pressure fittings (they're stronger than DWV/drain waste vent fittings). Use a GFCI (ground fault circuit interrupter) on all equipment around your pond.

Starting up your pond: After finishing construction, thoroughly rinse everything (don't clean with any form of soap). Fill the pond, dechlorinate the water and run your pumps and filters for a few days. Make sure everything is working fine. Test your water. After everything checks out ok, get 3 or 4 small koi (they're social animals and prefer some company). Don't feed them for the first few days. Watch your water quality and go easy on the food until your bio-filter is up to speed.

Water Testing

Keeping your koi happy and healthy requires that you keep their water in as good a condition as possible. There's more to good water than just H_2O. Natural water contains traces of every element and is teeming with micro organisms – some of these are good for our koi and some aren't. Listed below are the chemicals I believe you should be monitoring in your pond. I have listed the tests by order of importance. Notice that I have ranked alkalinity 2nd – with rubber lined ponds alkalinity can easily get too low and cause many problems.

Chlorine: Chlorine is used by water treatment plants to kill harmful bacteria. Chlorine is toxic to koi and must be removed from the water. Chlorine can be removed from the water by: aeration, filtration with carbon, or chemically neutralized with "de-chlor". If you are certain that your tap water concentration of chlorine is low and that its chlorine and NOT chloramine, then you can eliminate most of the chlorine with aeration – simply add new water to the pond by using a fine spray head on your

hose. Activated carbon filters also work well to remove chlorine – be sure to check the water coming out of your filter to make sure the filter is not exhausted and allowing chlorine to pass through. Dechlor is the surest way to neutralize chlorine. You can make your own dechlor by mixing 8 ounces of sodium thiosulfate with 2 liters of water. Always test your pond for chlorine after adding water. Be alert to high levels of chlorine in the tap water in the spring and after rain storms. Also, if you see construction work in your neighborhood be alert – sometimes they will dump in a bunch of chlorine if they have to work on the water mains. Chlorine is easily detected using tests such as Aquarium Pharmaceuticals liquid drop test kit. The test should be crystal clear – if you even see a trace of yellow add dechlor and test again.

Alkalinity: Alkalinity is a measure of the carbonates and bicarbonates in the water. Carbonates and bicarbonates act as a buffer. They will help raise the pH if other factors are bringing it down and they will help lower the pH when it is high. Carbonates and bicarbonates are also a vital part of the nitrification cycle – the bacteria require carbonates to function and they consume the carbonates from the water. You must replenish the carbonates to maintain a stable pond. In a concrete pond, the concrete will naturally leach out carbonates. In a rubber lined pond you will probably have to add carbonates to your water. You can control the alkalinity of your pond by adding baking soda. For testing, I prefer Tetra's total alkalinity test kit (it has a big KH on the box). I would suggest that you keep your alkalinity between 100 parts per million (ppm) and 150ppm. If you need to increase your alkalinity, use the following formula to determine the quantity of baking soda to use:

$$\text{ounces of baking soda} = \frac{\text{gallons} * \text{increase in alkalinity (ppm)}}{5000}$$

If your alkalinity is low (below around 80ppm) adding alkalinity will also raise the water's pH. Your bio-filter needs carbonates, but your bio-filter and fish also need a stable pH. If your alkalinity gets too low, stop feeding your fish, and slowly raise the alkalinity by 10ppm to 20ppm per day.

Ammonia: Ammonia (NH_4) is the primary waste product of koi. Ammonia is toxic to koi and must be neutralized, removed, or broken down into something else. Ammonia can be neutralized with chemicals such as Amquel. Amquel chemically binds up ammonia in a form that is not harmful to koi. Ammonia that is bound with chemical neutralizers will eventually be consumed by your bio-filter. Ammonia can be removed by using a filter containing Zeolite. There are thousands of varieties of zeolite and each type has its own characteristics – some are good for absorbing ammonia and some aren't. In my one experience with zeolite, it did nothing to remove ammonia so beware. Ammonia can also be handled by performing water changes. In a new pond or when adding fish to your existing pond, you may need to perform water changes to keep the ammonia under control until your bio-filter can catch up. The best way to deal with ammonia is with a bio-filter. The only way to get a fully functioning bio-filter is to give your pond time. Aeration is good for your pond, but it won't directly eliminate ammonia.

There are two basic types of tests for ammonia – Nessler and salicylate. Salicylate kits produce results having colors between green and yellow. Nessler kits produce colors between clear and yellow. I prefer to use a Nessler kit such as Aquarium Pharmaceuticals liquid drop kit for a quick check. If it is absolutely clear, then you don't have any ammonia. If the test is the least bit yellow, then I prefer to use a liquid salicylate kit to get an accurate measure of the ammonia. Note: if you're using a chemical ammonia neutralizer, then you must use a salicylate kit – the Nessler kits react to the ammonia neutralizer.

Nitrite: Nitrite (NO_2) is produced by bacteria as they break down ammonia. Nitrite is also toxic to koi and you should try to keep the level near 0. The only ways to control nitrite is with a bio-filter or water changes. When your bio-filter is getting started, you will see the ammonia level rise then fall. As the ammonia falls, the nitrite will start to rise. In time, the nitrite level will decrease as the bio-filter matures. You can monitor nitrite with kits from companies such as Aqua. Pharm.

pH: pH is a measure of hydrogen ions. A pH of 7.0 indicates neutral water. Values below 7.0 are acidic (the lower the pH, the more acidic). Values above 7.0 are considered alkaline. Your koi can thrive in water with pH between around 6.0 and 9.0. More important than maintaining your pH in a specific range is keeping the pH stable. Your koi can acclimate to a wide range of pHs, but they get stressed by water with changing pH. Maintaining adequate buffering (see above section on alkalinity) will help keep your pH stable. One factor that upsets the pH is the bio-filter. Your bio-filter consumes carbonates and produces acid in the process of eating ammonia. Another factor that can cause pH swings is green water – algae. Algae produce oxygen and consume carbon dioxide during daylight hours. At night, the process reverses and algae produces carbon dioxide and consumes oxygen. Carbon dioxide in the water is acidic. Changing levels of carbon dioxide result in changing amounts of acid and changing pH. You can minimize problems associated with carbon dioxide by providing ample aeration (which causes the CO_2 to be released into the air) or by keeping algae growth to a minimum.

Temperature: Temperature affects the metabolism of koi, the bio-filter, and every other living thing in your pond. A temperature that changes too fast or too often can stress your koi. If you see that your pond's temperature changes by more than a few degrees a day, then you should consider taking steps to stabilize the temperature. You can stabilize the temperature in the summer with shade. In the winter you can cover your pond and bypass the waterfall to reduce heat loss. You should not let the winter water temperature drop below about 38° F – temperatures below this can cause permanent damage or death.

Nitrate: Nitrate (NO_3) is the final product of bacteria breaking down ammonia and is relatively harmless. Nitrate is consumed by plants and algae. Plants and routine water changes should keep nitrate levels to acceptable levels. You can easily check the nitrate level using a liquid drop kit that changes color to indicate nitrate level.

Salt: Salt is commonly used for treating koi. If you intend to use salt, you should only do so if you can accurately dose your pond. Too much salt is harmful and too little will not be effective. Aqua. Pharm. makes a kit for testing salt. LaMotte's salinity test kit can be used with Norm Meck's special instructions (come to the March meeting for details). I've seen instructions for modifying an inexpensive specific gravity meter that has a floating plastic pointer that indicates salt content, but I would not suggest using this method since it is not very accurate.

When To Test

Chlorine – every time you add water, hourly during major water changes.

Alkalinity – weekly in warm months, monthly in cold months.

Ammonia - daily for a new pond. Weekly once your bio-filter is up to speed. Daily after medicating your pond or after significantly increasing your koi population.

Nitrite – weekly for a new pond until the ammonia starts to go down, then daily until the nitrite has gone up then down. Weekly once your bio-filter is up to speed. Daily after medicating your pond.

pH – weekly. Monthly for a mature pond if your alkalinity is kept above 80ppm.

Temperature – four times a day a few times through the year. Look for temperature swings of more than a couple of degrees in a day.

Nitrate – monthly first year, quarterly for a mature pond.

Salt – before adding more salt. After having added salt if your are the least bit unsure about your pond's volume.

Keep a close eye on your water after anything unusual (such as when you re-do your filter, your neighbor sprays his lawn, after you find a dead rat in the pond, etc.) You should also test your water whenever your koi are not acting normal. Don't assume that everything is ok.

Notes on Testing:

When performing water tests, you can get better results if you observe some good procedures. Keep your test vials clean. Dedicate specific test vials to specific tests to minimize contamination by chemicals from other tests. Clean vials immediately after use. View test vial in bright sun light against a white background. Hold dropper bottles vertically when dispensing chemicals and do not allow the drop to come in contact with the vial until it has dropped from the dispenser. Make sure your chemicals and test sample are warm (cold water can inhibit chemical processes). Do not trust readings at ends of scale – if you are testing for XYZ and the kit has a scale of 1 to 5, do not trust a reading of 5. A reading at full scale means that the result is the maximum OR GREATER. Use fresh test kits. Liquid test kits usually have a shelf life of around one year, dry powers and tablets usually longer (check manufacturers recommendations for exact life). Keep tests cool and dry to extend life (don't keep them in a storage shed that is subject to extreme conditions). Check date on bottle before you buy – distributors and retailers don't always rotate their stock well. Many test chemicals are caustic and/or toxic – avoid contact with skin and eyes.