

Chapter **NINE**

Fish Power For Your AquaponiGarden

In This Chapter

- **Pros and Cons of Different Fish Species**
- **Finding Your Fish**
- **Getting Your Fish Home Safely**
- **Caring For Your Fish**
- **Moral and Legal Obligations**


This chapter will make it easy for you to locate and bring fish home to power your aquaponic system. The weight (*not the number*) of fish you need to power each system is included in the materials list for each system in Chapters Six and Seven. If you can't get that many pounds of fish at first, get what you can afford, find, or catch; they'll get bigger. The reason for only using that amount of fish and no more is explained in this chapter.

You will be surprised at the variety of species you can use; and vegetarians will be pleased to know that you can use koi or other ornamental fish in your AquaponiGarden, so that it's not necessary to ever harm any fish in the process of growing your edible plants. Basically, any fish that eats (and last time we checked, they all do!) and poops (again, they all do!) will power your AquaponiGarden.

How The Fish Provide Nutrients

The vegetables in an AquaponiGarden grow by taking up nutrients that are dissolved in the garden's water. These nutrients are the soluble (dissolved) natural chemicals that are generated from what was put into the system in the form of fish food, and what comes out of the back end of the fish as fish waste. However, the soluble nutrients in the system water are harmful to the fish at high enough levels, as they build up over time. The beauty of these systems is that when you harvest vegetables, you're actually removing the soluble nutrients - they are the building blocks that allow the plants to grow. In a properly balanced aquaponics system, this cycle is what keeps the dissolved nutrients in the system at levels low enough to remain safe for the fish over long periods of time.

But without fish, there would be no nutrients at all in an AquaponiGarden. So one of the first questions you face is what are the choices for fish in your area, and of those choices, which fish would be best?



Definition

Nutrients are the nitrates (a chemical compound) and minerals that are dissolved in the water, that the plants use for growth. (Because these nutrients are dissolved, a more accurate and complete phrase would be "dissolved nutrients", but we'll just use the term "nutrients" for simplicity). The dissolved nutrients in an aquaponic system come from the breakdown of decaying organic materials in fish poop by various kinds of bacteria that live in the system (see Chapter One).

How To Pick Your Fish

To determine your choices for fish, you first need to decide if you're going to operate your system indoors only; or by moving it from outdoors to indoors when the weather gets cold; or only as an outdoors system (see Chapter Two). If your system is going to be outside for part or all of the year, you need a fish that can handle both the lowest and highest water temperatures that will occur in summer and in winter.

If you are in cold country, you should get a cold water fish such as trout or yellow perch, if possible. If you are in warm country, you can use a warm water fish such as tilapia, which is the fish species we use on our farm in Hawaii. If your location gets very hot in the summer and very cold in the winter, you will need to insulate the fish tank and trough, and run the water through a simple solar water heater in the daytime during cold periods to keep the water warm enough for your fish, or move them inside during extreme weather, when it's too hot or too cold.

If you are completely certain your installation will only be inside your house or apartment, you can use tropical aquarium fish, which are fish that thrive in warmer water. You can usually use these warmer water fish in an exclusively outdoors system if you are located in a warm environment.

How Many Fish Should You Get?

This is very simple: **For the 3.5, you need one pound of fish, total. For the 12, you need two and a half to three pounds total; for the 18, four to five pounds total.** How did we come up with these numbers? We a lot of research aimed at finding out the lowest acceptable range of fish mass that would still make enough fish fertilizer to work.

We figured out the **most** fish an aquaponics system could safely have in it, which is about one and a half to two pounds per square foot of raft area, if you use the proper aeration system, filtration tanks and operating protocols. We call this type of system a "High Density" system, or HD system, because of the high density of fish it contains. **We do not cover building and operating HD systems in this book.**

We also found out how **few** fish an aquaponics system needed in order to still grow almost all vegetables just as well as this system with the most fish; this turned out to be 0.3 pounds of fish per square foot of raft area. The required amounts of fish for the three systems in this book are based on this 0.3 pounds of fish per square foot of raft area. We call this type of system a "Low Density" system, or LD system, because of the lower density of fish it contains. **The LD system is what this book teaches you, because it's the easiest aquaponics system to build and to operate.**

Why Would I Ever Want To Grow Fewer Fish?

Isn't aquaponics all about growing the fish too, you ask? Most people think that is one of the main benefits of aquaponics. We did too, until the end of our first year of commercial operation, during which we raised 10,000 pounds of beautiful white and pink tilapia, and lost \$2.00 per pound on each and every pound of those fish. Yes, we lost \$20,000 that year on the fish we raised. Why?

It's simple: if your costs for fish food, electricity, labor, raising or buying your fingerlings to stock with are higher than the wholesale price you get for your fish, then you will lose money. Businesses track these things very carefully, because they make the difference between being in business next year, or out of business. Our cost of raising those fish was \$4.50/lb., and our wholesale price was \$2.50/lb.

It's a little (but not a lot) different for the hobby aquaponic gardener. You also have to buy electricity to run pumps; fish food to feed the fish; but your labor is free (sort of). But there are other problems inherent in trying to grow more fish: you can't just dump five times as much fish into one of these LD systems and leave everything else the same; you'll kill the system and the vegetables in short order. To understand why, please read on.

Economic Considerations

In these very small systems, you may be able to grow more fish without suffering the economic penalties we did; but there are other considerations: if you put a lot more fish into one of the systems in this book than the 0.3 pounds per square foot of raft area we recommend, you will be generating a lot more fish poop, which the bacteria and plants will not be able to clean out of the system water effectively.

Over a period of a month or more, you will have an ammonia spike, your plant roots will clog with the crud, and the bottoms of your troughs will go anaerobic (evil and stinky!) from all the extra decaying organic material coming out of the fish tank. The final result will be a dead and decaying system that won't grow plants at all, unless you build a system that

is designed for all this extra fish mass, with more area for plants, and perhaps even extra filtration to clean the water.

But nothing is free: for a system that can handle five times more fish, you will need a fish tank and an air pump that are five times larger; a solids settling tank; a net tank (also called a fine solids capture tank or "mineralization tank"); and a degas tank; plus all the extra plumbing between these tanks. Lots of fish means a more complicated system!

In addition to the higher purchase cost of the larger air pump, the larger fish tank, additional separate tanks, and the plumbing required to connect them together, you'll use five times the fish food and electricity, and spend more of your time caring for the fish. Then, you will have to empty and find a place to dispose of the sludge that extra filtration tanks will catch.

These HD systems also require a much higher level of technical expertise to operate than the simple and easy LD systems in this book, and to us, add unnecessary complexity to what can really be a simple home aquaponic garden. To keep these AquaponiGardens as easy to build and operate as possible, and because we've discovered how well these tiny systems grow food, we're certain that the LD system is the absolute easiest way to grow food in aquaponics!



A gorgeous eating-sized tilapia, which are possible to raise in a large enough fish tank.

Pros And Cons Of Different Fish

We cover a variety of different fish in this chapter, along with some of the pros and cons of each. The most important thing to understand is that any fish that poops and has gills will all work just fine for powering an aquaponics system. Knowing your high and low temperatures will tell you a lot about what fish will work well in your AquaponiGarden.

Make sure to check the laws in your area, so you don't accidentally get an outlaw fish!



You must put ten to fifteen mosquito fish (or similar small fish 1 to 1½ inches long) in each of your troughs. In Hawaii, we have tens of thousands of mosquito

fish in each one of the 80-foot long troughs in our systems, and we have no mosquitoes at all, not a normal situation in paradise.

Before we introduce all these fish for your fish tank, we need to mention that if your AquaponiGarden is outside (or if it's inside and you ever have mosquitoes in your house), then you will have created a mosquito breeding environment in your vegetable trough.

If they breed enthusiastically and successfully in your trough, and you are concerned about them eating plant roots, you can scoop out the extra fish (always leaving ten to fifteen in each trough) and retire them according to the recommendations in this chapter. But don't forget to put the initial stocking of ten to fifteen fish in your garden's troughs, or you'll have a mosquito farm soon, even indoors! Much more about mosquito fish in just a bit.

To Eat Or Not To Eat

Although many people focus on aquaponics systems with hopes and expectations of growing lots of fish, what these systems do very best is grow lots of vegetables. Thus, powering your AquaponiGarden with non-edible fish is a viable option if you are primarily interested in the vegetables.

If you do want to grow lots of fish, please read Chapter Seven where we will briefly explain what's involved in doing this, and the conditions you will need to meet in order to have your fish be happy and healthy until you're ready to harvest them for the occasional meal.

Using a non-food fish is not a drawback, though, because the two of the three standard AquaponiGardens in this book have tanks that are too small to raise fish to edible size anyway. If edible fish are one of your goals, you can use the information in this book to custom-design a larger system with a fish tank large enough for edible fish. In this case, you will probably want to use one of the edible fish described in this chapter. Apologies in advance to both the animal-rights people and cat lovers for saying this, but if you use goldfish for your garden, and end up with too many, you can just feed them to the cat. If you drop a live fish in front of a cat, the cat thinks she caught the fish herself, and she'll be ridiculously proud of herself, and she may even bring you one of them, as cats do sometimes, when they really want to impress you!



Definition

Although many cultures in the world will eat fish as small as two to three centimeters (one inch) long, we'll define **edible fish** as those species commonly used for this purpose: trout, catfish, tilapia, perch, and similar types of fish. If you want to raise edible fish, put a larger fish tank in your system than the standard tank specified in the system plans (We show you how to do this in Chapter Seven.)

Goldfish

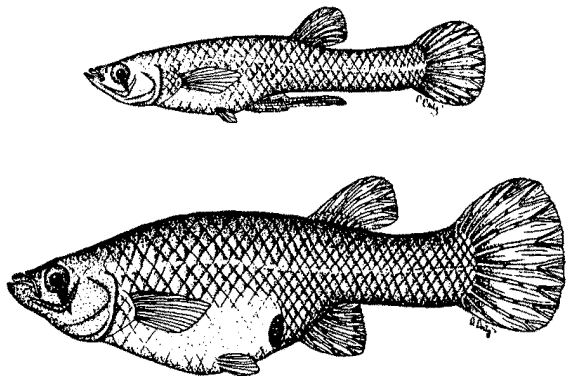
Goldfish are colorful and visually attractive, hardy, robust, and fairly tolerant of temperature swings. They can usually be purchased inexpensively at a pet store, or found in a friend's ornamental pond at no cost. They're very hardy, and can handle a water temperature range from 60°F/15.6°C up to 85°F/ 29.4°C. They also eat almost any kind of manufactured fish food that you may use.

On the negative side, goldfish are known for producing a lot of ammonia. This can pose a problem during startup, or if you accidentally overfeed your fish (although this is hard to do with a mature aquaponics system). Goldfish can get relatively large (we've had goldfish in our systems weighing over one pound), but they are not considered a food fish. If one of your goals is edible fish from your system, consider one of the other fish described here. Also, be careful, because goldfish from pet stores can sometimes come with disease.

Mosquito Fish, Guppies, Mollies, Tetras, and Cichlids

These are some of the most easily found fish, almost all of which can be purchased at pet stores. We include Latin names (shown in italics) to identify fish throughout this book, because they identify only one fish, so there's no confusion.

Guppies and mollies are brightly colored, have long wavy tails, and are also live-bearing (as opposed to egg-laying). You may also use tetras, which is a common name that refers to many unrelated fish; or cichlids, which pet stores often have a large variety of. One of your main criteria for selection here will be price, so look for any of these fish that are economical to purchase; they will all work just fine in your system. But also be on the lookout for attractive fish, if they fit your budget; there's no reason the fish in your aquaponics garden need to be drab and boring.



Mosquito fish *Gambusia affinis*. Male on top, female on bottom.

HINT

If you can't find enough of one type of these different fish, ask the pet store salesperson which types of fish can peacefully live together in a tank, and use a combination of those types.

Remember, any fish that poops and breathe through gills will work.

The common mosquito fish, (*Gambusia affinis*)

All of these types of fish can often be purchased inexpensively at a pet store, or can be found in a friend's pond at no cost; so they're easy to source. They're also very hardy, and can handle the same water temperature range as goldfish: from 60°F/15.6°C up to 85°F/ 29.4°C. They also eat almost any kind of manufactured fish food that you can find.

However, unless you come from a culture that considers two-inch long fish and edible fish, these will never get big enough to eat. Since you probably won't be eating them, your fish population can easily be reduced with the previously described "cat disposal technique". If your main goal is the vegetables, and you're not planning on eating your fish, then this is an easy solution.

Mosquito fish, though small, are reputed to fight and harass other fish unless the other fish are considerably larger. However, in our systems we've never seen this happen.



Long-tailed guppy (*Poecilia reticulata*) a gravid (pregnant) female



Neon tetra (Paracheirodon innesi)



Electric Yellow Cichlid (Labidochromis caeruleus)

They are hardy, robust, will eat anything, are fairly tasty (for you fishetarians), and can be from a few inches up to several feet long when adults, depending on the species. If you're getting catfish as an eating fish, buy some first from the grocery store to check them out, to see if you like the taste. We love catfish, but some people don't, so much.

If you have a small tank, you can either get small ornamental catfish from a local pet store, or fingerling catfish from a catfish breeder to stock your aquaponics system. They are forgiving of low-oxygen events, such as when your air pump fails or the cat knocks the cord out of the outlet. They will eat all kinds of things that tilapia, trout, bass, and perch turn their noses up at (make sure you read the Chapter Ten, about what to feed your fish, as there are some cautionary remarks there about safety of various fish foods).

Catfish are known for being explorers, and if you have left them any way to get out of the tank, they will. You will find them on the floor in the morning, halfway across the room. They've developed this ability to be able to move from a small pond that is drying up to a larger one where they have a better chance at family, fortune, and fame. They do it by squirming out of one pond and squirming over to another, cross-country, at night, when it's coolest and they will lose the least body moisture to the atmosphere.



Catfish (Ictalurus punctatus)

Catfish

We've heard from experts that there are catfish in almost every naturally-occurring body of water in the world where the water never gets below 35-38°F/1.67-3.3°C. They can handle up to 90°F/32.2°C water temperature, although they don't like it, so they are a good candidate if your location has cold water in the winter and warm water in the summer. If you're in a cold location, source your catfish from a cold location, don't ship them in from Florida; conversely, if you're in a warm location, don't ship them in from Michigan.



*This is a blue tilapia fingerling, **Tilapia aureus**. Note the protective glove for use with all spiny fish!*

Tilapia

Tilapia are very similar to perch, but are found in bodies of water almost everywhere in the world that never gets below about 60°F/15.6°C, because they die in colder water). We have know of tilapia doing OK at up to 95°F/35°C water temperature, though they don't like it.

They are hardy, robust, and eat a variety of food, since they are omnivores. If you have a small tank, you can either get small tilapia-like fish called cichlids from a local pet store, or fingerling tilapia from a tilapia breeder. In large tanks, tilapia can grow up to one pound in six months, and up to seven pounds in three years, depending on water temperature and feeding schedule. Like catfish, they are also relatively forgiving of low-oxygen events.



Definition

An **omnivore** is an animal that eats both plants and animals. Tilapia are omnivores because they will eat algae (when they're young), smaller fish, frogs, insects, broccoli stems, and lettuce leaves.

In some places, tilapia are not legal to possess, because they can get into waterways and out-compete the native fish. Think "someone who will do my job for half as much pay", and you will understand the tilapia's extreme ability to adapt, and the reason there's a problem. Be responsible and check with your local State Fish and Game Department before getting tilapia. Tilapia up to six inches long will eat any smaller tilapia (or other smaller fish) they can catch, so you can't mix tilapia this size with fish two inches long and smaller. When your tilapia are bigger than six inches, they're too slow to catch smaller fish, and can safely be put in a tank with any smaller size fish.

Koi (Or Asian Ornamental Carp)

The koi, or Asian ornamental carp, is found everywhere that tilapia are found. Their temperature range is the same as tilapia, they eat the same foods, and they eat smaller koi (and tilapia!) just like tilapia do. One thing different about koi is that you can often find koi for free! Koi breeders are selecting for fish that have certain patterns and colors; koi breeders consistently throw away as many as 95 percent of the fish they hatch out, because they have the wrong colors or pattern. However, there is nothing wrong with these fish for aquaponics purposes; they all work just as well no matter what their color.

So if you can locate a koi breeder, ask them when their next hatch is, and if they will save you some "discards". You may be asked to pay a small amount for the breeder's trouble; he has to hold fish for you to pick up that he would normally compost or feed back to the bigger ones, and it helps defray his costs.



*Friendly koi, or ornamental Asian carp (**Cyprinus carpio**)*

HINT

If you are seriously drawn to koi, you may want to look into breeding your own. It's not difficult, and for the rare breeder who is both good and

lucky, can be rewarded with fish sometimes worth up to five figures. We're not saying this is easy, for it requires years of study and hard work, just like everything else that's worthwhile. However, there's nothing to soothe one's mind like a pond of peacefully milling koi.

Trout

Trout are found in cold bodies of water; sometimes there will be ice covering the surface of a trout stream in the wintertime; they're definitely a cold-water fish. This is to your advantage if you're in a primarily cold place; it means you will be able to grow with less insulation, possibly outside, in colder climates. Trout can handle up to 75°F/23.9°C water temperature, although they don't like it; their preferred temp is 50-55°F/10-12.8°C, which is not optimal for the vegetables (60-75°F/15.6-23.9°C), but they should still grow fairly well. If you're in a cold place, and cannot bring your AquaponiGarden inside or insulate it, then you should use trout.

Because they are cold-water fish, it will be easier for you to maintain your aquaponics in a cold climate. They taste good. They can handle fairly large temperature fluctuations, and are commonly available from trout hatcheries all over the northern parts of the continental USA.



Brown Trout (*Salmo trutta*). There are many species of trout. They all taste good! Use whatever you can find in your area.

There are some potential drawbacks to using trout: they are carnivores, which means you have to feed them an appropriate high-protein diet, which may be hard to find, expensive, or both. Make certain you have a source of trout food before purchasing your trout! They will happily eat smaller trout, so you can't use a mix of large and small fish, or you'll just end up with big ones. They are sensitive to water quality, and require clean water just to keep alive. If you overfeed your system, or a fish dies and you don't notice for a few days, the resulting ammonia spike can kill every trout in your tank, while tilapia or catfish in the same situation would just be a little uncomfortable.



Definition

A **carnivore** is an animal that eats other animals. Trout are carnivores and will eat frogs, insects, smaller trout, and other fish, but will not eat algae, broccoli stems, and lettuce leaves. They're meat-eaters, period.

Trout may be difficult to source: we've never heard of getting trout at a pet store. You can't take fingerling trout from a stream because it's not lawful to catch or possess them smaller than the limit size (check the laws in your area, it's usually eight to 12 inches length, depending on species). So you are probably limited to purchasing small (or full-sized legal) trout from a trout hatchery, if you can find one. They're great fish, they may just have a lot of legal requirements to satisfy. We suggest only using trout if you've had previous experience with aquaculture and/or aquaponics, and know more than a little something about trout.

Other Fish

Other fish that could be used besides the ones mentioned already include but are not limited to: crappie, bluegill, sunfish, perch, walleye, pike, muskellunge, smallmouth and largemouth bass, striped bass, and many others.

These fish are usually only available wild-caught in fairly large (legal) sizes, or are often only grown in large aquaculture operations requiring a lot of technical expertise and specialized equipment. Many of them are carnivorous, and you will have the same problems mentioned in the section about trout. If you have special knowledge of one of these fish which allows you to confidently use it in your home aquaponics garden, by all means go ahead. Make sure to obey all State and Federal laws regarding that fish in the process, as you do not want to run afoul of the authorities.



*Malaysian Tiger Prawn (Macrobrachium rosenbergii),
in the bottom of a 5-gallon bucket.*

Freshwater Prawns

We are growing prawns in our vegetable troughs in addition to the tilapia in our fish tanks. Prawns are delicious and exciting, and everyone wants to grow them instead of fish. There are a couple of minor problems with this, however.

Prawns are extremely territorial, and fight each other, with the loser becoming the dinner of the winner. Commercial prawn farms stock baby prawns (called "PL's", for post-larvals, or juveniles) into their ponds at a density of three to four for every square yard of pond area; and then harvest about one mature prawn per square yard, a few months later.

It doesn't matter if they stock 20 per square yard, the prawns simply fight with and eat each other until there is only about one mature prawn per square yard at harvest.

What this means for the 12 is one prawn in each one of your vegetable troughs. That is, if you can find the four or five baby prawns you need to stock your troughs with. There are only a few places in the US that hatch them. For example, we know of a prawn hatchery has a minimum order of 100,000 prawns, for \$2,500, not including shipping. Sigh. But, ask around, just in case!

Where Do I Find My Fish?

You can go the easy way and purchase them from a pet store or hatchery, or be a pioneer and catch them yourself. But you should do this in a way that works for you. If you've never gone fishing before, you should try the pet store. If you are a fishing fan, it will be very satisfying sourcing fish yourself at a favorite lake or stream. Just remember to take a garbage can and an air pump instead of a cooler full of ice for bringing your fish home.

Even if you simply purchase your fish from a pet store, you will still need appropriate gear for handling those fish. You may need to move fish temporarily to another tank during startup or at other times. You'll need to harvest fish from your system when they get too big. So, get a pair of those gardening gloves with the rubber sticky-dots all over them to use for handling your fish (usually about \$3 in Wal-Mart or Home Depot), and a fish net with a handle that has a mesh smaller than the smallest fish you will need to catch.

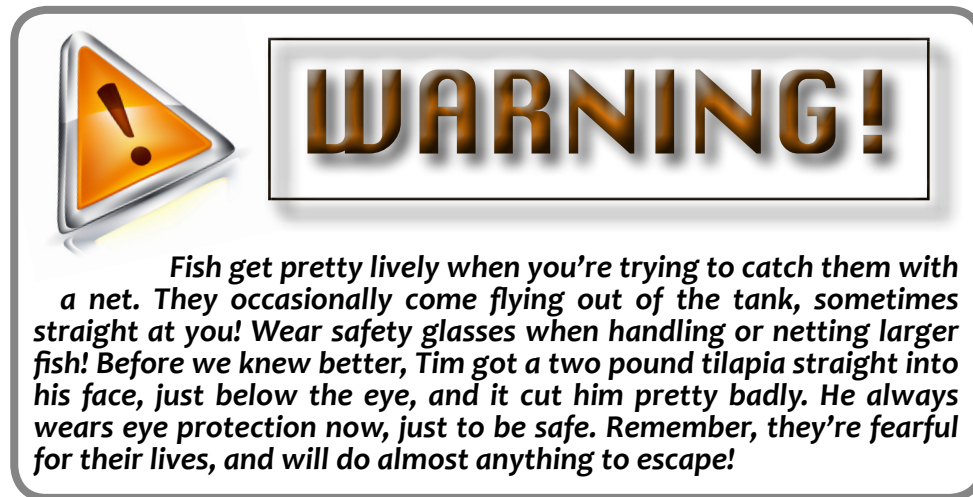


WARNING!

Get your fish home as quickly as you safely can, and don't let them heat up in the car on the way home; you can cook them! Make sure to keep the water in the transport "tank" (this can be a plastic bag, bucket, or garbage can) reasonably cool; and make sure the air pump to the airstone in the fish transport "tank" is always on.

The fish net needs to be small enough that you can get it inside your fish tank, and getting two is a good idea, because then you not only have a spare net, but it's much easier catching fish with two nets: you can use one net to herd them into the other net.

Why do you need the gloves if you've got the nets? Because fish are spiny critters, and one or two will sometimes jump out of the tank when the net comes in; then you have to scoop them off the floor quickly with a gloved hand (for your protection) and put them where you want them.



Go Fishing: Wild-Caught Fish

You can go fishing with any legal methods, to catch legal-size fish for your system, if your system tank is large enough to house these fish. Make sure that your methods are lawful, that your hooks, nets, and other fishing gear are all the correct and legal size, and that you only keep fish that are larger than the legal minimum sizes, in the proper amounts that are lawful to catch and possess for your area.

Wild-caught fish are usually the most healthy you can get; but be on the lookout for any fish with deformed fins, cuts, or white spots; these should go into the frying pan or back into the lake or stream instead of into your aquaponics system, as they may be carriers of disease. Err on the side of caution, with any fish you bring into your system.

Get Them From The Hatchery

If you have a fish hatchery in your area, you can procure all different sizes of fish from them. How do you find a hatchery? Call the nearest State University and locate their Agricultural Extension Office. This office will have people called "Agricultural Extension Agents", or even better, "Aquaculture Extension Agents". It is their job, paid for by the Federal government, to tell you what aquaculture resources, including hatcheries, are available in your area. You may also be able to source fish from an aquaponics farm, if you can locate one.

"My Friend Has A Pond"

This option is "Go Fishing" combined with "Get Them From The Hatchery". Your friend will give you/sell you some fish, but it's up to you to get them out of the pond. Ponds are usually deep and murky, and the fish in them are skilled at escape and evasion. Unless you have special equipment and skills, or your friend offers to get the fish out of the pond for you, we suggest you give this one a pass, as it's quite likely to be a lot of trouble to get "free" fish. But have a lot of fun, if you try!

How Do I Get My Fish Home?

It's much easier to get groceries home than to get fish home, safe and alive. Unless you have ice cream in your shopping bags, groceries are a lot more forgiving than fish. However, it is easy to transport fish, and without even getting water on the inside of your car or car trunk, by using the methods described here.

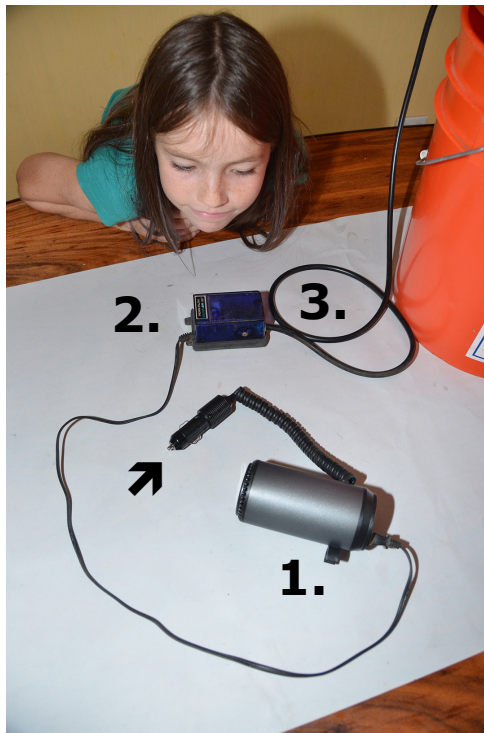
Pet Store Fish

These are really simple, as most pet stores put the fish you purchase in oxygenated bags of water, so that all you have to do is put the bags in a cardboard box, then go home and put them in your fish tank. Make sure to put the unopened bag into your tank for an hour to equalize the temperature before opening the bag and releasing the fish.

Fish From a Pond, Stream, Hatchery, Or Another Aquaponics Farm

You may be able to get the people from whom you purchase fish to deliver them. If you can't, here's a recipe for delivering your own fish, safe, sound, and healthy. You will use either a 5-gallon bucket or 20-gallon plastic garbage can that you will fill to the top with water, when you pick up the fish.

Before going to get your fish, drill a small hole through the center of the bucket or garbage can lid, and put one of your system airstones on a length of airstone tubing in the bottom of the bucket or garbage can you will use to haul fish. Connect the airstone in the bucket or can to the air pump from your garden. Connect the air pump from your garden to an "inverter" that plugs into the charger in your car and powers it, found at Radio Shack or auto parts stores, for about \$15. When the bucket or can is full of water and fish, turn on the air pump to keep your fish oxygenated and alive.



But wait! Your system air pump is at home, in the aquaponics system, waiting for the fish to arrive, right? No, it's temporarily being used to provide aeration through the airstone in the water in your haul bucket or can. When you get home, transfer the fish into your fish tank, and put the air pump and airstones back into your home system, then turn it on so your fish have air to breathe.

This is a 5-gallon haul bucket with a lid, air pump and AC adaptor:
1. Inverter, that plugs into the charger in your car (arrow); 2. Air-pump, plugged into the AC adaptor (also called an inverter); 3. Air-line, with an airstone connected to it, inside the 5-gallon bucket.

You will need to make certain this bucket or plastic garbage can is tied down very well inside your truck, car trunk, or vehicle you're hauling it with. A 5-gallon bucket full of water weighs 40 pounds, and will go flying in a turn if not tied down. A 20-gallon garbage can full of water weighs 160 pounds, so tying down is even more critical.

When you haul fish, handle them as little as necessary and as gently as possible. If you need to handle them directly, if they have jumped onto the floor, for instance, you should have a pair of knit gardening gloves with the sticky rubber dots or lines on them. With these gloves, it is easy to safely pick up a slippery, spiny fish and put it back in the bucket. Put the gloves on **before** you start trying to net any fish, so you are prepared in case they "fly", and remember the safety glasses! Touch the fish as lightly and as briefly as possible, because the goal is to keep your fish's slime coat intact, as damage to this slime coat affects fish the same way that losing skin would affect a person.


It's very important to use the right net. It's nearly as difficult to catch fish without the right net as it is to catch birds with your bare hands. Your net must be small enough to fit inside your fish tank and/or haul tank, in order to net up fish that are inside it. It must also have a small enough mesh that the smallest fish you are using cannot fit through holes in the mesh. Use your good sense when buying a net, in consideration of the fish you need to move with it. Also, it is often easier to net fish using two nets at the same time, either working with both hands, or with the help of another, to drive the fish into the net more easily.



Two appropriate nets of different sizes for the 5-gallon bucket fish tank (bottom), and the 20-gallon garbage can fish tank (top).


Rose, at eight, loves being my model!

When moving your fish from your supplier's fish tank to your haul tank, just pick them up in the net, and move them carefully to their new location, without banging them into anything along the way. Move them quickly, and gently empty them into your haul tank by putting the whole net, fish and all, in the haul tank water **then overturning it underwater and letting the fish gently tumble out.** Don't just upend the net and dump them out in the air above the haul tank; this will damage the fish! Do the same at home, when you're transferring them into their new home. If it's difficult to net a fish (often the very last one!), remove half the water from the tank and it will be a lot easier to catch.



WARNING!

Handle and load your fish as gently as possible, and fill your haul bucket all the way to the top with water and cover with a solid cover. This prevents the water from sloshing, which stresses the fish and increases fish mortality. Handle the fish as little as necessary and as gently as possible when transferring from the haul tank to the fish tank at home. (More on this in Chapter Eleven, "Starting Your AquaponiGarden").



Definition

A 120 volt AC/DC car charger inverter is a piece of electrical equipment you can usually purchase for \$15 to \$20 at a hardware store or an auto parts store. It plugs into the charging socket in your car and takes the DC (Direct Current) electricity from the car battery and turns it into AC (Alternating Current) electricity, which is the same as the electrical outlets in your house. You plug your 120 volt AC air pump into this adaptor, and yay! You now have aeration in your car for keeping your fish alive during transport.

How Do I Care For My Fish When They Arrive?

It's important to understand that your fish will probably not be at all hungry for a few days after the haul; even if you have had no mortalities, they're going to be in shock. Even if they act interested in the food, don't feed the fish anything for the first few days. They won't like it, but it won't hurt them, and it will ensure that ammonia levels stay low, which is very important for proper system start up. **Make sure you read and understand Chapter Eleven, "Starting Your AquaponiGarden", before going to get your fish.**

When you do begin feeding your fish, feed them just what they will completely consume in a ten to fifteen-minute period. We explain in detail how to feed your fish in Chapter Ten, "Commercial and Homemade Fish Food".

A few days after you've gotten your fish home, and they've been in their tank for about a week, with ammonia levels nice and low (under two parts per million; we'll explain this in detail in Chapter Eleven), your fish are starting to eat, and all looks well. Another week goes by, and you may notice a couple of dead fish one morning. What's this?

Well, you may see two separate periods of mortality coming after your fish haul. The first fish that die within the first three or four days after the haul are the fish that were so badly damaged or stressed in the haul that they died relatively soon from their injuries and trauma.

A second batch of fish might die between ten days to two weeks after the haul. These are the fish that were more lightly damaged or stressed during the haul - not enough to kill them outright, but enough to compromise their immune systems (yes, they have immune systems, just like us!). These fish probably had light injuries, then died from the fishy equivalent of a cold or the flu a couple of weeks after the haul because they were already weakened. **As always, quickly get the dead fish out of the tank!**

After this second few deaths, as long as you feed your fish correctly, are very gentle when netting them, and keep an eye on your water quality, you should have happy, healthy fish for a long time. To continue our car analogy, the motor for your AquaponiGarden has now been installed!

Edible Fish (For Fishetarians)

Your fish will grow. At some point they might even become larger than can comfortably live in your fish tanks, and they will begin to get stressed, get ill and/or die. The smallest sized "fish tank" we recommend for these systems is a 5-gallon bucket, which can comfortably house a 1/8- to 1/4-pound fish, which is barely eating size in American culture. It's possible to grow eating-size fish in the larger of the two systems with its 30-gallon trash can "fish tank"; or you can put a larger fish tank on the small system - we explain this in detail in Chapter Seven. If you are using edible fish in your system that get fairly large (such as tilapia, trout, bass, or any of the perches), you can simply net the largest fish in the tank, then prepare them however you like (we love them with butter and garlic), and eat them.

A humane way to kill fish to eat is to put them, live, into a bucket or cooler with five or six inches of ice and water. They will slow down, then simply stop being alive when their temperature gets down below about 50°F/10°C.

We've adopted a bit of American Native tradition when it comes to eating fish or meat of any kind: when we kill fish to eat, we thank them for their lives, and for providing nourishment for us and our family. We do it reverently and with respect, in full awareness that the fish's dying means that we get to live and be healthy.



WARNING!

If you have fish that you need to "get rid of", but you don't want to eat them, you must do it responsibly and lawfully. Even if you got your fish by netting them from a stream or pond, it may not be lawful to put them back in that same stream or pond once they're too large for your aquaponics system. Laws on this vary by jurisdiction, you need to find out what the law is in your area by calling the local State Fish And Game Department; they will explain what's legal and what's not.

To fully and completely respect the fish, you cannot simply throw away the parts you don't use. We take all the parts of the fish we don't eat and either feed them to a hungry cat, or compost them for use on in-ground plants. When we do this, our in-ground plants flourish and grow beautifully! This applies also to plants in pots, if you do not live in a place where you can plant in the ground.



You will want to take the fish bones and compost them separately from all the flesh, as the bones take a long time to decompose and make "pokies"

for quite a long time in your compost and anything you use it on. If you accidentally step on them, or get one in your hand, it will hurt, and could possibly get infected! Be very careful with compost that contains fish bones - just be aware of where you put them, and be careful when you walk in that area in the future!

Non-Edible Fish (And For Vegetarians)

If you are a vegetarian or just plain don't like the taste of fish, you'll be happy to find out that you don't have to use edible fish. Your AquaponiGarden can be powered by a non-food fish. But please realize that some of the species of non-food fish will get large as well, and will need to leave the small tank, just like a child who grows up to be six foot seven and gets a college basketball scholarship. If you don't eat them, you must still retire these fish responsibly.

If you have koi, you may be able to find a restaurant or hotel with a koi pond that will take your fish; you may also be able to donate them to a school science class with a large aquarium or pond. If you have food fish, you can give them to a friend who eats fish (respectfully!), if you feel OK about that.

But you can't simply dump them into a pond or stream without understanding the consequences, some of which may be legal consequences. Even if there are no laws against dumping them, unless that pond or stream is their

natural habitat, with good water quality and plenty of food, you may simply have consigned your retired fish to a short life numbered in hours or days, full of suffering for the fish. It would be more responsible and less wasteful of their lives to kill them humanely, then feed them to the cat.

So, if you've checked the laws, and it's legal; and if you understand that the ecosystem in the stream or pond in question is a good match for your retiring fish; and if you can get them to the stream or pond relatively undamaged, then this is a good choice. It's like retiring a hard-working horse to pasture, but continuing to feed and care for it in appreciation of what it did for you over its lifetime. Remember all those vegetables you ate? Thank you, fish!

Aquaponics Is EASY When You Remember:

- That you don't need to use edible fish, you can use many types of attractive aquarium fish, because they all work just as well on a per pound basis.
- You know to get healthy fish that match your temperature range, and that are inexpensive and easy for you to feed and maintain.
- That when transporting fish, keep trauma to a minimum by using aerated containers with lids that are filled to the very top with water.
- That you don't feed your fish unless they are eating, because the leftover food simply sinks, decays, and causes problems in your garden.
- To remove dead fish from the tank as soon as possible, this is important to keep water quality high, and ammonia levels low.
- To retire fish responsibly and intelligently, as there can be legal consequences of dumping fish in waterways, as well as moral ones.



Rose and Tim, and two of our gorgeous white tilapia.