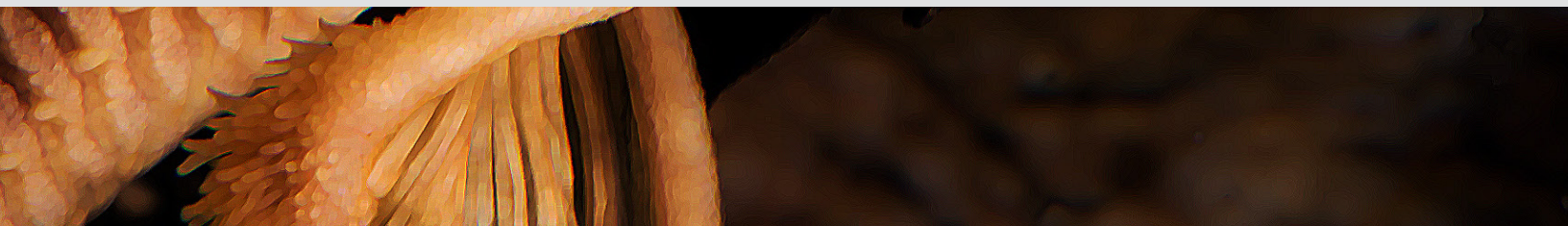
Segrest Farms™

AQUARIUM FUNDAMENTALS:

WHAT YOU NEED TO KNOW TO SET UP A FISH TANK



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Why Did We Write This Book?

There's a stat that gets commonly shared through the aquarium industry: out of everybody who buys their first fish tank, half of them will forever give up on keeping fish within six months.

This is a terrible attrition rate. There are all of these people who clearly have some interest and desire to keep fish, but for whatever reason can't stick with it for more than a few months. We think that this is both sad and unacceptable.

The loss of this many potential hobbyists is obviously bad for those of us who sell fish, and if you're one of those looking at getting your first aquarium, a 50/50 chance of failure and defeat can be daunting. But what's less obvious is how it's bad for the more experienced hobbyists out there. Why should it matter to them what happens with some newbie to the hobby?

The strength of the entire hobby rests on the cumulative backs of everybody involved. The entire marketplace of live fish and aquarium supplies depends on having people who are interested and looking to be active in the hobby. More hobbyists means more fish stores and more equipment options available. It means that there may be enough demand for less popular fish to begin getting bred and increasing their availability. It means having more people trying to figure out challenges and problems in the hobby and increasing the available knowledge base to make possible those accomplishments that were previously considered impossible.

Having more hobbyists is good for everybody involved. But what happens with these new fishkeepers? What drives them out of the hobby, and how can we lower the failure rate?

At the end of the day, somebody who is willing to invest the money in an aquarium is going to give up because they're not prepared to keep fish in the first place.

Some of this will be the result of impulse buys. Someone walks into a fish store, sees a fish they think is pretty, and gets the absolute bare minimum they need, walking out in five minutes with a few bags and no understanding of how to be successful. They don't know how to properly care for fish or what fish need to survive, so they end up with dead fish. They don't know what maintenance they need to do to keep their fish tank clean, so they end up overrun by algae and with a tank that smells.

No animal, including fish, should ever be an impulse buy.

There are other people who make an effort to prepare, but get bad advice. Whether this is the result of believing old wives' tales about keeping fish, talking to somebody who kept them a few decades ago and has only a partial memory of now outdated methods, or even un undertrained fish store employee who gives bad advice, these people are frustrated when they fail despite following advice and doing what they think is right.

We believe that if more people are prepared from the start, from before they ever bring home their first fish, that fewer tanks will fail, fewer people will quit in defeat, and we can help the hobby become stronger.

What We Hope You Get Out Of This Book

There's a lot of information out there about fish, and a lot of it is good, but a lot of it is not.

More problematically, there is a lot of information that, while it's not wrong, is incorrectly presented as being indisputable fact. There are a lot of areas that fall into a sort of gray zone, where different people can have different ideas and methods yet still be successful. What works for one situation may not work for another one. There are times when there truly is no right or wrong answer, yet people will argue that their belief is the only way to be successful.

The underlying principles of keeping aquariums are pretty clear and straightforward. It's in the details where

things get a bit murkier. We hope to give you a strong foundational understanding of these underlying principles so that you can be successful with whatever aquarium you want to keep.

That being said, this book is not a comprehensive resource. There are entire books written about many of the individual topics covered here. You can spend a thousand pages talking about the different species that are available in the aquarium trade and still not get to all of them. It's impossible to cover everything that anyone might want to know in one book.

And, if we're being honest, once you dig down into any of these topics deep enough, it becomes inaccessible to anybody but the most dedicated practitioners. While it may be of interest to some people, trying to identify a particular species by the number of rays in their dorsal fin is going to be outside of the needs or interest of someone just getting started. Knowing that there are groups of bacteria that break down ammonia and nitrite is important to all aquarists. Trying to figure out what exact species are present in what exact conditions is going to be overwhelming to most.

Our goal is to give enough insight that even more experienced hobbyists can get some value from this book while also remaining accessible enough for the first time aquarist who is planning to buy their first fish.

After reading this book, you may not know what a specific fish needs to thrive. You may not know what water parameters it prefers, what kind of diet it eats, or how it's going to get along with other fish. Instead, we hope you'll have a strong enough foundation that when you do additional research into that fish (and you should research every individual fish you buy) that you'll understand what is important to know about that fish and how to apply it in your aquarium.

We may not tell you that a certain fish is native to Lake Malawi, but when you learn that it is, you should know that it needs relatively high pH, relatively hard water, and probably likes rocky environments with lots of caves, and that you should probably avoid trying to keep it with a species native to the Amazon. And, more importantly, you'll know how to set up your aquarium to provide those things.

If there's one significant hole in this book, it's marine aquariums. In order to keep the book from getting too long and overwhelming, we tried to focus on topics and concepts that are universal across all aquarium types, but this does lead to a bit of a freshwater bias.

That doesn't mean that somebody who wants to keep saltwater fish won't be able to get anything out of this book. Many of these topics are vital to saltwater success, just as they are in freshwater. Marine aquarists need to understand the nitrogen cycle, the importance of pH and water hardness, and what characteristics of fish you need to consider when stocking your tank. A lot of the equipment used in freshwater can be used in saltwater as well.

But there are methods and techniques that saltwater aquarists need to learn to be successful that aren't covered in this book. The aspiring saltwater hobbyist will need to do some additional research before starting their tank.

How This Book Is Organized

Because we are trying to give a fairly comprehensive overview of what you should understand as a fish owner, a lot of the book takes a wide angle view at a lot of topics. We want you to understand these topics well enough to make your own decisions. We generally won't tell you "this is what you must do." Things are rarely so black and white.

The first few chapters, especially, will take a broad approach. We take a quick look at why we keep aquariums and how they've evolved over the past hundred and fifty or so years. We discuss the general scientific concepts that are important to an aquarist, but we don't necessarily tell you exactly how you need to approach your tank, because your goals will likely be different from somebody else's. There is no single pH or level of water hardness that every single aquarium needs to hit, for example.

As we get further into the book, we will look at more specific scenarios, but even then it will be your decision as to how you want to approach your aquarium. The goal is that each chapter will build on the concepts presented earlier, allowing you to have a better understanding once you reach the end.

We hope that this book can help you achieve greater success as you go through your fish keeping journey.

Brighton Aquarium
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Public aquarium in Brighton, England, circa 1890-1900

1 WHY DO WE KEEP AQUARIUMS?

Fish are unique from almost every other animal that people keep as pets. You can't hold a fish. They won't cuddle with you. They don't really have any of the characteristics that people traditionally consider "cute." The environments fish come from are about as alien as you can find on Earth. To successfully keep fish requires learning a new set of skills and understanding concepts you may otherwise never need to think about.

Yet despite all of this, people have kept (or at least tried to keep) fish for much of our historical records. Some of the oldest civilizations that we have discovered have left behind evidence of keeping fish for one reason or another. What is it about fish that has driven us to keep them for so long, and how has the aquarium hobby as we know it come into existence?

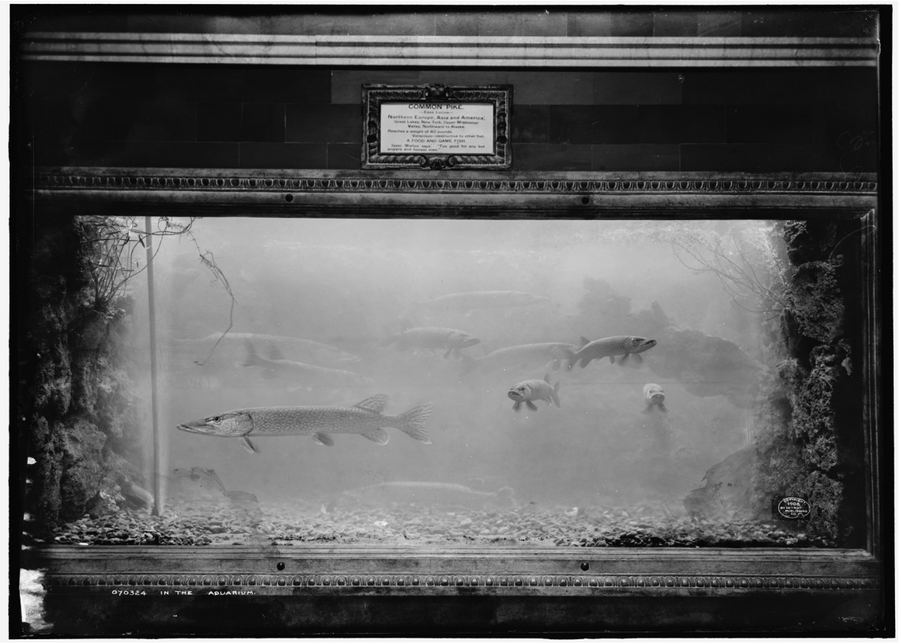
A Brief History of Keeping Ornamental Fish

Earliest Records of Keeping Fish

Fish have been kept by people for thousands of years, and unsurprisingly the earliest roots of fish keeping began because of almost entirely utilitarian reasons. The earliest records of people keeping fish come from the Sumerians roughly 4500 years ago, followed by the Babylonians, Egyptians, Romans, Chinese, and other civilizations. Fish were kept in artificial ponds in order to be easily accessible as a food source.

Fish have been an important food source for almost as long as humanity has existed. But like all wild meat sources, there is never a guarantee that you will be able to find an many as you need. If a fisherman had an exceptionally bountiful harvest, taking the extra fish that weren't going to be immediately eaten and storing them for later guaranteed you would have food available. The best

Belle Isle Park Aquarium Library of Congress, Prints & Photographs Division, Detroit Publishing Company Photograph Collection, LC-DIG-det-4a22191
Photograph of the interior of the Belle Isle Park Aquarium in Detroit, Michigan, circa 1900-1910



Pike Aquarium Library of Congress, Prints & Photographs Division, Detroit Publishing Company Photograph Collection, LC-DIG-det-4a22535
Tank of pike circa 1908, probably at the Belle Isle Park Aquarium

way to keep the fish as fresh as possible for as long as possible was to build ponds where they could continue to live a fairly natural life until you did need them. And thus fishkeeping was born.

The Romans are notable during this process for being the first group to develop ways to keep marine fish. Like other cultures they would utilize ponds for keeping fish, but their engineering prowess allowed them to build systems to bring in a constant supply of seawater to fill and replenish the water in their ponds.

Humans have long had an affinity for animals, and the same drive that caused people to keep other animals purely for companionship purposes can be seen in fish as well. While the majority of early fish keeping was to maintain a food source, there are reports of people growing attached to certain fish and refusing to let them be taken for food.

The most prominent example of this comes from Asia. The Japanese and Chinese were probably the first to have any degree of success in breeding fish (as opposed to just catching them), creating what can be considered the earliest fish "farms" for carp. They were also the first to start selectively breeding them for specific aesthetic traits. These carp would eventually transform into the koi and goldfish we know and love today and by around the 10th or 11th century they were actively breeding these fish for purely decorative purposes.

The Growth of the Aquarium

Keeping fish in artificial ponds is relatively straightforward, at least provided the water chemistry and weather for your area are more or less correct for those fish. And if you keep fish native to your area, as most of these early examples of fishkeeping likely were, then all it really takes is building a pond, ensuring that it doesn't dry out, and throwing the fish in there. When you try to keep fish in small containers indoors, though, things begin to get a bit more complicated.

To keep fish indoors, you have to ensure that their water stays clean and that you're not allowing fish waste or other pollutants to build up. You potentially have to worry about keeping the water aerated enough that the fish have a sufficient amount of oxygen. Indoor temperatures, even in the days before air conditioning, are probably going to be somewhat cooler than outside under direct sunlight (at least during the warmer summer months), so you may have to worry about how to maintain the temperature of the water. You have to figure out how to feed the fish, as they won't have any naturally present insects or other edible substances.

Without having knowledge of these concepts, most early attempts at bringing fish indoors didn't fare very well. It is believed that Romans would utilize indoor tanks as temporary holding containers to keep fish as fresh as possible before preparing them to eat. However, these early tanks would be unlikely to be able to keep them alive long term.

The ornamental carp being bred in Asia were often highly prized, so perhaps unsurprisingly there was a fair bit of motivation to be able to bring them indoors. They would use large ceramic vessels to showcase their fish indoors. It seems logical that the extreme hardiness we see today with goldfish is likely the result of efforts to breed them to survive in such containers in spite of the limitations these early tanks possessed.

The first major advancements in fishkeeping would begin in the 1800s as more scientists started trying to unlock the secrets to successfully keeping fish in tanks. It was during this period that the term aquarium was first used by English naturalist Philip Henry Goss, who would later go on to create the first public aquarium exhibit at the London Zoo in 1853. The English chemist Robert Warington is credited with developing the idea of the aquarium by utilizing plants as a tool for oxygenating the water, in essence creating a complete ecosystem and (inadvertently) utilizing a basic filtration method to eliminate fish waste without relying solely on replacing the water.

While most early 19th century aquarium enthusiasts were limited to the wealthy and elite classes, the Fish House at the London Zoo was easily accessible by the general public, bringing the idea of the aquarium to the masses for perhaps the first time and catapulting the interest in keeping fish to new heights.

With the massive popularity of the Fish House, other cities were quick to build and open their own public aquariums. Within a few years, a number of major cities such as New York, Boston, Paris, Hamburg, and Berlin all had their own aquarium exhibits.

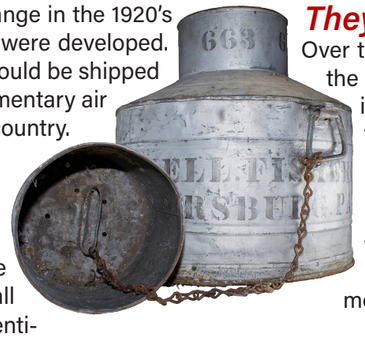
Between the rapidly increasing interest in keeping fish and the new possibilities brought about by the industrial era, the pace of new developments quickly increased. Many 19th century aquariums were essentially wooden boxes with a glass front, but better adhesive and sealing materials soon led to the development of metal framed aquariums with glass sides.

Slate bottoms were developed that allowed rudimentary heating before the development and widespread use of electricity. These slate bottoms allowed small fires to be lit under the tank in order to heat the water. The first mechanical air pump, which was powered by running water, was developed shortly after the turn of the 20th century.

After World War 1, the increasing availability of electricity to houses spurred the development of new equipment for aquariums such as new electric heating devices, air pumps, and early filtration.

At this point, most of the fish available for aquariums were native species that were being collected from the wild. With the exception of goldfish and other carp, there was still a very limited amount of captive breed-

ing occurring. This began to change in the 1920's as the first fish farms in Florida were developed. Captive bred fish from Florida would be shipped by train in metal jugs using rudimentary air pumps to locations around the country.



The Modern Aquarium Hobby

As technology increased the speed of innovation across all industries throughout the twentieth century and into the twenty first, advancements in aquarium tools and knowledge continued to progress. Early versions of most of the equipment we still use had been created in the first half of the twentieth century, but they would continue to evolve and improve.

Both academic researchers as well as home hobbyists would continue to study aquariums and aquarium fish in order to unlock the secrets to their success. The process of the nitrogen cycle in the aquarium became better understood, allowing fish keepers to avoid exposing their fish to toxic compounds.

Better materials allowed aquariums to be made that could resist the corrosive power of saltwater, allowing marine tanks to become more common. Aquarists figured out how to care for animals that were previously considered impossible such as corals. Local and regional aquarium clubs sprang up, allowing aquarists to connect and share ideas.

Very likely the biggest innovation to advance the hobby has been the internet, which has simplified passing knowledge and experience from one fish keeper to the next, dramatically reducing the learning curve to achieving aquarium success by making all of the knowledge one might need easily accessible. There are few fish that are still considered impossible to keep.

Fishkeeping has been opened up to anybody with the desire and willingness to learn.

Why Do We Still Keep Fish?

Despite such a long history of people being drawn to keep fish, having an aquarium is still a fairly niche hobby. But what is it about keeping fish that has kept this drive going for more than four millennia?

They Connect Us to Nature

Over the past one or two hundred years, much of the population (at least in the United States) has increasingly concentrated into urban centers. Even relatively small cities are much larger and more developed than even large cities were a couple hundred years ago. The growth of cities is, in many ways, a great advantage, allowing a sort of consolidation of resources and experience that fosters even more growth.

However, the benefits of this population shift come at the cost of isolating us from nature. Humanity's early history required us to be constantly connected to nature, and that intrinsic connection remains in many people. Most fish are still undomesticated animals and can represent that direct link to nature that is normally cut off.

Using aquariums to strengthen this connection can be taken even farther. A number of aquarists have become increasingly interested in keeping biotope aquariums, which seek to recreate a small slice of a natural environment in a tank. When you take a tank, decorate it in a way that echoes a specific river or lake, and then add plants and animals native to that body of water, you are able to create a window into a part of the world that you may otherwise never see.

For a number of people, there's a sort of empathy that is created where this personal connection to the tanks and fish we keep expands to the regions those species originally came from as well as to other populations of those fish that we aren't keeping in aquariums. This creates a powerful motivation to work to protect habitats and species. These aquarists devote their attention to various conservation methods in order to further satisfy this connection.

Some of these aquarists have worked with species that are threatened, endangered, and even extinct in the wild. The aquarium trade has also motivated conservation efforts in remote parts of the world, with collection operations driving habitat protection in those regions.

Personal Benefits

Beyond this connection with nature, there's a range of benefits they offer to the aquarist.

There is an incredible drive that is seemingly innate in many people that motivates them to care for other creatures. It's what pushes us to keep companion pets. The earliest dogs and cats were likely domesticated for utilitarian purposes such as protection, help when hunting, and eliminating pests, but the development of breeds intended solely for companionship fills a strictly emotional void within people.

Fish may not be companion animals that you can hold and cuddle with, but they can still satisfy this need. The positive reinforcement of a fish learning its owner and excitedly begging for food can be enormously motivating. Setting up a tank, meticulously caring for it, and being rewarded with fish regularly spawning and raising babies can powerfully validate that you are doing well.

There is an increasing body of research that shows that the presence of a fish tank can have beneficial qualities by providing a calming influence that reduces stress on those around it. There is evidence that aquariums in the waiting rooms of doctors' offices can help reduce the blood pressure, heart rate, and anxiety of patients waiting to be admitted. Some dentists have reported that patients need less anesthesia and pain medicine when the waiting room contains fish.

There have also been studies and reports of fish tanks proving to be beneficial in classroom settings. The same benefits that are seen in doctors' waiting rooms (reduction in stress and anxiety, lowering blood pressure, etc) can be seen in students. Teachers who work with special populations, such as children with autism, seem to particularly notice benefits from a classroom aquarium.

Perhaps the most obvious and basic benefit of an aquarium in a home is adding beauty and a focal point of interest into a room. Aquarium fish are often referred to as "ornamental" fish, reflecting this role as a source of visual beauty and interest. Some people have used an aquarium to replace a television as a focal point in the room, noting that they can command a similar degree of attention while providing a calming influence.

For those who are interested in the practices espoused by feng shui, aquariums play an important role in a house. The principles of feng shui say that, if properly placed, the water and the fish in an aquarium can bring luck in both money and career for a person as well as counter negative energy. This is why you often see aquariums near the entrance to Asian restaurants.

Whether or not you believe in the feng shui characteristics of fish tanks, it's impossible to deny that an aquarium, particularly a larger tank with a more significant presence, can dramatically alter the mood and atmosphere of any space.

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Aquarium hobbyist, circa 1941

Visit The Aquarium
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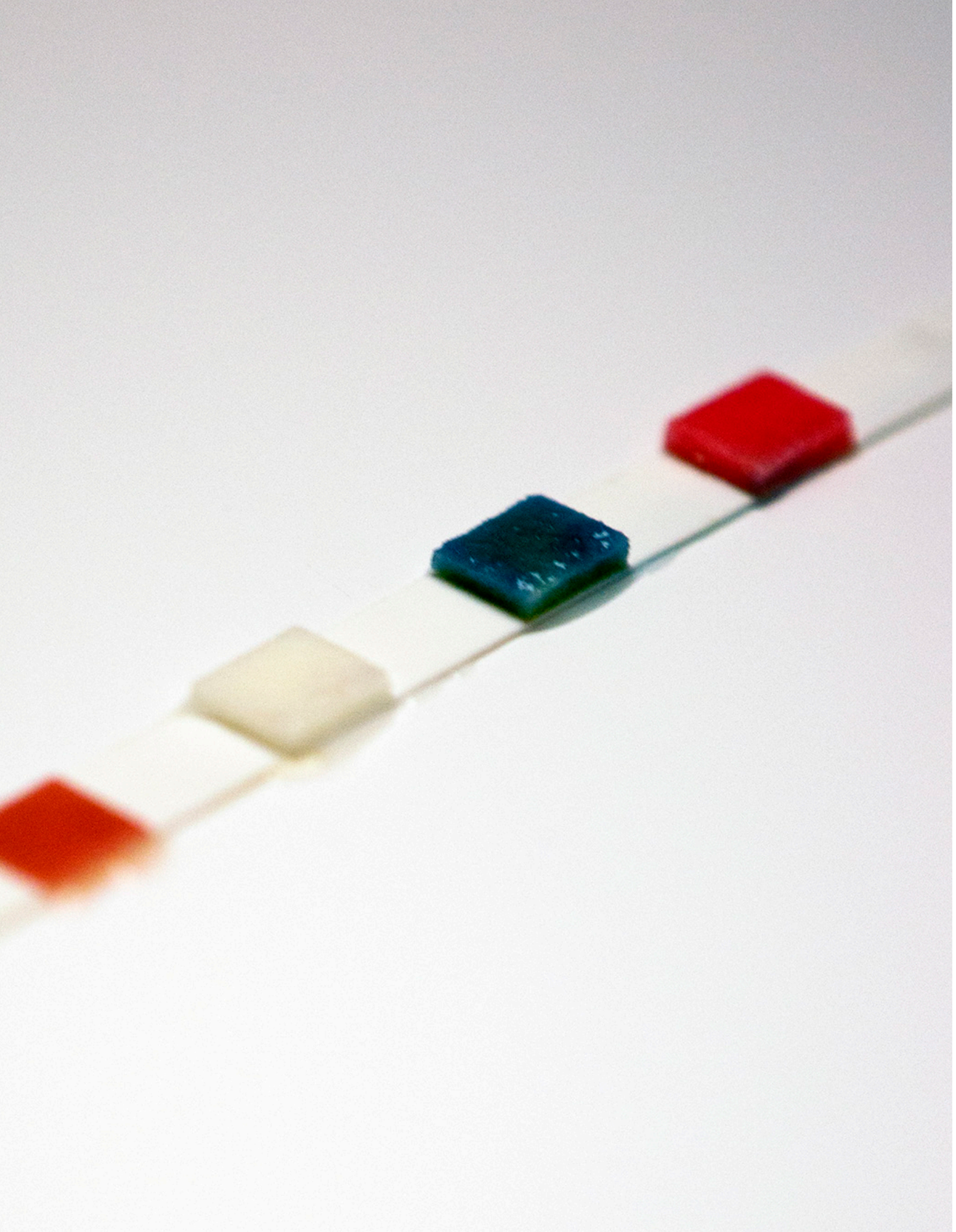
1937 promotional poster for the public aquarium at Fairmount Park (Philadelphia, PA)



2 THE SCIENCE OF AQUARIUMS

Keeping fish is, in a few important ways, fundamentally different from keeping any other pet. Unlike keeping a dog, hamster, or bird, keeping fish requires dealing with the challenges of what is largely a closed system.

What does this mean? An ***open system*** is one in which materials or energy can be freely exchanged with the environment outside of that system, while a ***closed system*** is one that is fully self-contained. You can view systems at a number of different scales and within the frame of specific substances.

For example, the Earth as a whole can be thought of as both an open and a closed system. All of the air, nutrients, and elements on Earth are more or less already present. We're not getting new air from the solar system or eliminating unwanted nutrients by blasting them into space (for the most part, at least). In that sense, the Earth as a whole is closed. However, the energy that drives life on Earth is being constantly supplied from the sun, and a certain amount of radiant energy is lost to the universe, making it an open system as well.

Looking at a smaller scale, most habitats are open system. For example, a lake may be supplied fresh water from rain while flushing their old water down stream until it eventually reaches an ocean. Plant seeds may be introduced by being blown in as spores and then fed by light from the sun. The fish that live in that lake may eat insects that fly in from different areas. All of the building blocks for life in that lake are naturally introduced while waste products are readily eliminated.

Aquariums, though, are largely closed system. There is some degree of gas exchange between the water and the atmosphere, but as a fish keeper you have to supply and remove virtually everything from the water. When toxins build up in the water, they must be removed by the aquarist. If the fish needs some level of salt in its water, that must be supplied by the aquarist. Unless you are lucky and crafty enough to live by a body of water and can set up a system to perpetually supply fresh natural water to your fish, it all comes down to you.

Because of this, you need to be aware of what essential factors fish need and how to avoid potential problems. That starts with a basic understanding of water chemistry.

Water Chemistry 101

Everybody learns in their basic science classes that water is one atom of oxygen bonded to two atoms of hydrogen. Repeat this an unimaginably large number of times and you have enough water to fill a fish tank. However, almost no water on Earth is pure water. All but the most extremely filtered (or chemically produced) water has gases, salts, minerals, organic matter, and other substances dissolved in it. And this is a good thing. What is dissolved in the water determines how well that water will support life.

Chlorine and Chloramines

The very first substances you need to be concerned about when setting up a fish tank are chlorine and chloramine. If you live anywhere that receives its water from a public water utility, that water has been treated in order to make it safe for you to drink. Traditionally, chlorine gas has been used to sterilize water, killing any bacteria or parasite before they can make you sick. Unfortunately, chlorine will also quickly kill your fish.

The problem with using chlorine to sterilize water is that, if left standing, it tends to dissipate from water within a day or two. For aquarists, this was good news. You could put water into a container for a few days and it would become safe to use in your aquarium. However, it also increased the chance for harmful organisms to appear and cause significant health problems if you drank water after the chlorine had dissipated.

To combat this risk, most water treatment facilities switched over to using chloramine, which is the result of bonding chlorine with ammonia. Chloramines are just as lethal to microorganism (and fish) as chlorine, but can take weeks to break down. Once they break down, you are left with both the chlorine (which will dissipate in a day or two) and the ammonia (which will be consumed by nitrifying bacteria).

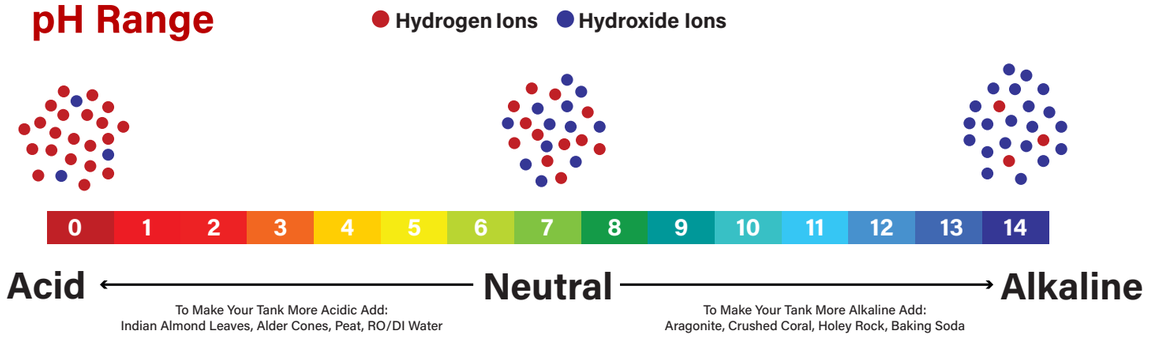
Most people don't want to wait weeks before putting water into their aquarium. Fortunately, though, there are many products available that will neutralize both chlorine and chloramines almost instantly. Some of these will also bind with the ammonia produced, reducing its toxicity as well. Additionally, these dechlorinators are extremely safe for your aquarium's inhabitants and will not poison your fish even if heavily overdosed.

If you live in a rural area and use well water, you probably don't need to worry about chlorine or chloramine. But if you're not absolutely certain about whether or not they exist in your water, it's generally a good idea to use a dechlorinator just to be safe.

pH

pH and the acidity of water is a topic that can be extremely complicated, but only a basic knowledge is needed in order to care for your aquarium. The simplified version is that sometimes water molecules will break apart. A lone hydrogen ion will go off one way while the remaining hydrogen and oxygen stay together as a hydroxide ion and go somewhere else.

Sometimes, though, one of the ions will bond with another substance. The ion that is left over will then start to build up. ***pH*** is simply a measurement of the ratio of hydrogen to hydroxide ions. A pH of 7.0 is neutral, with roughly the same number of hydrogen and hydroxide ions. When you have an overabundance of hydrogen ions, the water is ***acidic*** and the pH is below 7.0. Conversely, when you end up with more hydroxide ions floating around, the water becomes ***alkaline*** and the pH is above 7.0.



Why does this matter? Both hydrogen and hydroxide ions will react with different substances. Your fish have evolved to live in water with a fairly specific pH, and thus are most adapted to dealing with the effects of that pH. While they may be able to adapt to a different pH over time, large pH swings will cause them stress, weakening their immune systems and making them more prone to illness.

There are several factors that can influence the pH of an aquarium. Many types of rocks as well as coral skeletons can contain various types of carbonates that elevate the pH by bonding with hydrogen ions. Substrates such as crushed coral and aragonite are commonly used in African cichlid and marine aquariums to naturally maintain the higher pH of these fish's natural habitats.

POND PROBLEMS

Many pond keepers approach pond creation and maintenance as a DIY project. Digging and lining the hole, placing rocks to hide the liner, and decorating pond to mimic nature are all part of the appeal. However, sometimes pond keepers are faced with pH that seems to be insurmountably high.

Sometimes, this is the result of the materials used in the creation of the pond. It's not uncommon to use limestone slabs or concrete block for a variety of purposes. Both limestone and concrete readily react with carbon dioxide to form calcium carbonate, often driving the pH to unmanageably high pH levels.

THE RIO NEGRO

Think, for a minute, about fish from the Rio Negro. This hot spot of extremely popular fish, including cardinal tetras, freshwater angels, discus, and cory cats, is a blackwater river whose pH can plummet to below 3.5 during certain times of the year. Many aquarists want to recreate these conditions in order to provide their fish the most natural habitat possible, especially those who seek out wild collected fish.

However, there is a problem here. While the fish may be collected in water with a pH of 3.5, their journey to your local fish store is a long one, and every step of the way they have to acclimate to less and less acidic water. This process can potentially take a month or more. By the time you pick them up from the store, they're probably used to living in water that is fairly neutral or even slightly alkaline. If you immediately dump them into your aquarium that has been carefully set up with authentic blackwater conditions, they will be extremely stressed and likely to die.

Should you keep them in the same condition as your store, or should you try to recreate their natural environment? The choice is yours! Above all else, you want to keep your parameters stable. If you're not comfortable maintaining precise water conditions and your water source is close to neutral, it's probably best to not try and mess with it too much. If you do want to recreate their natural habitat, it can bring out more natural behaviors and potentially encourage your fish to breed.

If you're going to move your fish from neutral parameters to very acidic water, do so gradually. Set up a quarantine tank that matches your store's conditions as closely as possible and slowly reacclimate them to more acidic conditions. Not only will this help eliminate the shock of a sudden pH change, but it will also allow you to watch them for any disease you don't want to introduce into your main tank.

Check out this Video The Journey of a Piaba Fish

General and Carbonate Hardness Charts

General Hardness °GH	Calcium/Magnesium Oxide in mg/l (or ppm)	Water Conditions
0 - 4	0 - 70	Very Soft
4 - 8	70 - 140	Soft
8 - 12	140 - 210	Medium Hard
12 - 18	210 - 320	Fairly Hard
18 - 30	320 - 530	Hard
30+	530+	Very Hard
1 dGH = 17.9 mg/l (ppm)		

Carbonate Hardness °KH	Total Alkalinity in mg/l (or ppm) calcium carbonate	Water Conditions
0 - 3	0 - 53.7	Unstable pH, Low Buffering Capacity
3-5	53.7 - 89.5	Moderate Buffering Capacity
5 - 10	89.5 - 179	High Buffering Capacity
10 - 20	179 - 358	Marine Levels
20+	358+	Marine Levels
1 dKH = 17.9 mg/l		

Hardness

Water hardness has the potential to be confusing, primarily arising from there being two different qualities referred to as hardness. For the most basic aquariums, a rough idea about hardness may be enough. But for more advanced aquarists, having a solid understanding of these concepts can open up doors to new levels of success.

What do we mean when we refer to water hardness? ***Water hardness*** is just a measurement of how many minerals are dissolved in the water. ***Hard water*** has more minerals dissolved in it, and ***soft water*** has fewer dissolved minerals. The two different types of hardness measure the concentration of specific minerals in the water.

General hardness, often labeled GH, is a measure of the amount of calcium and magnesium in the water. When people refer solely to water hardness without specifying which one, they are often talking about GH. General hardness can have a direct effect on fish health, with certain fish having evolved for higher or lower general hardness levels. Trying to keep a fish native to soft water regions in water with a high general hardness (or vice versa) can be detrimental or even lethal to your fish.

Carbonate hardness, often labeled KH, is a measure of the amount of carbonates and bicarbonates that are in the water. Carbonate hardness doesn't directly affect fish health, but it does directly affect pH. The most important role of KH in an aquarium is to buffer and stabilize the pH of the aquarium. Carbonates (and bicarbonates) will readily bond with hydrogen ions, and having higher carbonate levels in your aquarium allows them to "collect" the extra hydrogen ions that are naturally produced, preventing them from lowering the pH of the aquarium.

It often seems that pH, GH, and KH are inextricably linked. Many times, harder water will have a higher pH while softer water will have a lower pH. Keep in mind, though, that this is just a generalization, and there are times where it won't be true.

How concerned should you, as an aquarist, be about your water hardness? Like with pH, fish have adapted to live in areas with certain water hardness levels. Also like with pH, fish can be fairly adaptable to their environment. Unless your water is extremely different from their natural environment, stability is almost always preferable to dialing in to a specific value.By far, the most common substance that influences hardness is calcium carbonate, which is found in many rocks, crushed coral, aragonite, limestone, concrete, and other substances. The carbonate from calcium carbonate will readily raise the KH (and likely the pH as well). At the same time, the calcium raises the GH, largely tying the three values to each other.

It can be difficult, but not impossible, to influence only one of these three factors. Baking soda (sodium bicarbonate) can increase the KH without affecting GH (because there is no calcium present), but the pH will most likely rise as well. Epsom salt (magnesium sulphate) can increase GH without adding any carbonates and affecting KH.

Adding hardness to water is much easier than removing it. Substances that leach tannins into the water such as

MAJOR AQUARIUM FISH SOURCES

ORIGIN	EXAMPLE FISH	pH	Temperature	Hardness
Central American River	Central American Cichlids	7.0 - 7.6	72 - 80	Low to Moderate
Amazon Basin Clearwater River	South American Cichlids, Many Tetras	7.0 - 7.5	75 - 82	Moderate
Rio Negro/ Blackwater River	Discus, Cardinal Tetra, Angelfish	4.5 - 5.5	78 - 86	Very Low
West African River	Synodontis Catfish, African Tetras, Mormyrids	6.8 - 7.5	78 - 82	Low to Moderate
Lake Tangyanika	Shelldwellers, Synodontis Catfish	7.8 - 9.0	75 - 82	High
Lake Malawi	Mbuna, Peacocks	7.8 - 8.6	72 - 82	High

If you want to recreate a fish's natural habitat, research the natural conditions found there and slowly acclimate them to those conditions.

driftwood, Indian almond leaves, and peat can remove carbonates, softening the water and lowering the pH. However, if you truly want to soften the water in your aquarium it's best to start with the softest water possible and remove anything that will add additional minerals to your tank. Setting up a reverse osmosis filter to prepare your water will remove a lot of the minerals in your water. Reverse osmosis/deionized (RO/DI) filters will strip almost all minerals from the water. Distilled water is also largely free of dissolved minerals.

The problem with extremely soft water is that it is very vulnerable to swings in pH. Without the buffering properties of carbonates, you lose a lot of stability in the water. However, there are fish that have evolved to thrive in soft water, so it is sometimes worth it to try to provide those conditions.

While it's not particularly difficult to raise or lower the hardness of your aquarium water, it can require a bit of care, effort, and (if you choose to invest in an RO/DI system) expense. If you're looking for the easiest setup, find out the "natural" conditions of the water you have access to and choose fish that will thrive in that water without any additional effort on your part.

Total Dissolved Solids

Total Dissolved Solids, or TDS, are often overlooked by aquarists despite having perhaps the greatest impact on the health and well-being of your aquarium. TDS is a measure of all the dissolved substances that are present in your water. It measures almost everything that you can't see or filter out with a mechanical filter such as calcium, magnesium, carbonates, salts, ammonia, nitrates, phosphates, silicates, and more.

In fact, some people will argue that out of all the different ways to monitor water chemistry, TDS is potentially the most important. This is because it is responsible for driving one of the most fundamental properties of water: osmosis.

There are a lot of problems that can happen when you put a fish into water with a significantly different TDS than it is either accustomed to or adapted to handle. Many times, when people refer to fish as needing be kept in high or low pH, or hard water or soft water, they're really talking about fish that need a certain TDS level without even knowing it. The African rift lakes, in addition to being hard water with high pH, are also high in TDS levels. Parts of the Amazon basin have extraordinarily low (almost unmeasurably low) TDS levels. Where TDS causes problems is when it creates an imbalance in osmotic pressure between the inside of a fish's cells and the water environment it lives in.

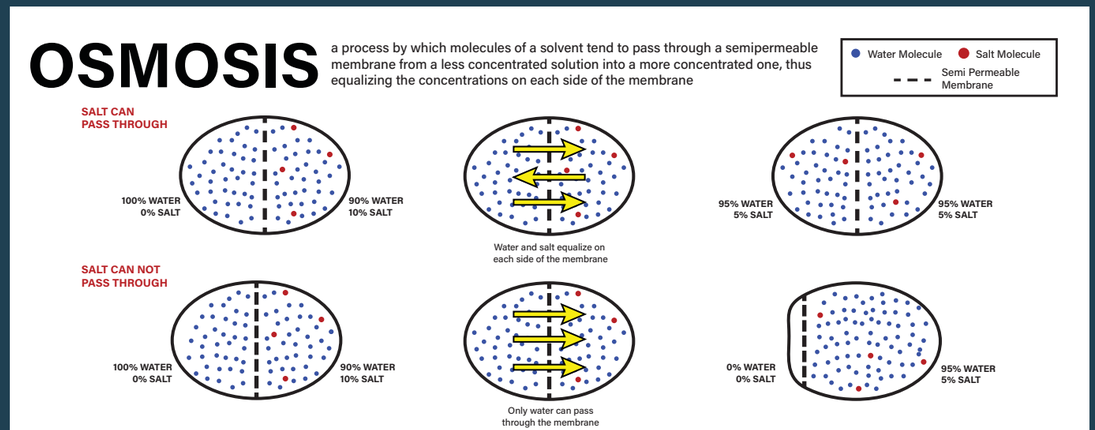
Fish that live in areas with very high TDS levels, such as marine fish, have adapted to cope with an environment where the water they live in has a higher concentration

SCIENCE 101 – OSMOSIS

We've established that water almost always has something dissolved in it. You can think of the dissolved substances as unsociable people – they don't want to be any closer to each other than they absolutely have to. Put a bunch of them in one place and they're going to move as far away from each other as possible. When this happens in open water, it's called diffusion. When it has to happen through some sort of a membrane (such as in and out of the cells of a fish), it's called osmosis.

Imagine you have a membrane with very salty water on one side and pure water on the other. If either the salt or the water can pass through this membrane, it's going to try to reach equilibrium with the same concentration of each on both sides. This might happen in two ways. If it can pass through the membrane, salt from the salty side will move into the pure water side. Simultaneously, water will move from the pure water side into the salty side. This will happen until both sides have as low of a concentration of both salt and water as possible, which will happen when the two sides reach equilibrium in their saltiness.

Sometimes, though, the membrane doesn't allow one of the substances to pass through, and it's up to the other substance to do all the work. If the membrane in the example above didn't allow the salt to pass through, water will continue to pass through from the pure side to the salty side until there is as low of a concentration of both salt and water as possible on both sides of the membrane. Because the concentration on the pure water side will always be 100% pure water, all of the water will end up moving from the pure side to the salty side.



of dissolved substances than exists inside their cells. This creates osmotic pressure that wants to pull water out of their cells and push in those other substances. Their bodies actively work to take in more water and expel those substances to compensate for the problems osmosis will create.

At the other end of the spectrum, soft water fish that come from low TDS areas have to force excess water out of their cells while osmosis drives more in. They don't have a mechanism for protecting themselves from losing too much water from osmosis because they never had to evolve one. If you put them into water with very high TDS (which will likely also be high pH, hard water), they'll actually start to lose water to their environment and eventually dehydrate.

Because TDS is so closely tied to both hardness and pH, it has been easy for people to overlook it. And in reality, many aquarists won't necessarily have to worry too much about it if they can keep their pH and/or hardness in line. But if you're having problems with fish dying for no discernable reason or being unable to breed a fish despite having otherwise perfect conditions, you might have a hidden TDS problem that needs correcting.

Salt

Perhaps the most controversial topic in all of freshwater aquarium keeping is whether or not your aquarium needs to have salt added to it. There are lifelong, highly experienced, and well regarded aquarists that will tell you that salt is vital to keeping fish healthy and no tank should be without it. There are equally renowned aquarists that tell you that you shouldn't add salt to any of your tanks.

"Salt" does not refer to one single substance. There is a wide range of salts, and they can be made up of a wide range of chemical compounds. Some people will use common table or rock salt (sodium chloride), while others will use salt that is made from or reproduces the salt in sea water which may also contain additional calcium, magnesium, potassium, sulfates, and more. Planted aquarium keepers often use salts containing nitrates and phosphates as fertilizers for their plants. For this section, though, we'll stick to looking at what you might get if you go to a fish store and pick up a box with "Aquarium Salt" written on its side.

Manufacturers of aquarium salt generally don't tell their exact formulas, so it's hard or impossible to know exactly what you are adding. Most of the time, it will likely be some form of rock salt or sea salt, but how do these affect our aquarium?

The most immediate effect of adding salt is going to be that it will raise the TDS level of your tank. Depending on the fish you're keeping, this might be a good thing or a bad thing. If you are keeping fish such as cardinal tetras that need low TDS levels, you might think twice about adding salt to your aquarium. If you keep African cichlids, you may be more likely to add salt.

Many people will argue that adding a small amount of salt will ease a lot of stress that fish face. Even fish that are adapted to extremely soft water have to deal with some level of osmotic pressure trying to pull minerals out and push water in. A little salt can push the water chemistry closer to what is inside of the fish and ease this pressure somewhat. The more pure water is, the faster osmosis happens, so slightly salty water will decrease the rate osmosis wants to occur.

While there are definite limitations, most fish are able to handle at least limited changes in TDS fairly well. Many of the bacteria and parasites that can be harmful to fish, though, are much more vulnerable to such changes. Thus, adding salt has long been a method used by many aquarium owners to treat diseases. There is often a sweet spot where the bacteria or parasite will die from the change in TDS but the fish will be relatively unaffected. Many people recommend around 2 teaspoons per gallon for this approach, though keep in mind that it might be different depending on the other chemical properties of your water.

Because rock salt is only made of sodium and chlorine, you can use it to raise the overall TDS of an aquarium without affecting the pH or hardness of that aquarium. Most of the time, though, pH, hardness, and TDS are so closely tied that you wouldn't have a reason to want to do so, but it is always an option.

Certain fish, such as scaleless catfish, are extremely sensitive to salt. If you are keeping these types of fish, then you will probably want to avoid using salt in your aquarium in general.

Obviously, there are certain fish that you absolutely must give salt to. Keeping marine fish in a freshwater tank is going to lead to a very rapid death. Additionally, there are a number of popular fish that come from brackish environments, where fresh and saltwater meet. While many of them can survive at the extremes, they will best thrive when provided with a certain level of salts. Freshwater eels, archer fish, monos, and even the ever popular molly are native to brackish waters.

One thing to keep in mind whenever you are using salt is that it won't evaporate. If all you're doing is topping off your aquarium as water evaporates and adding salt each time, you are going to slowly increase the salt concentration in your aquarium. If you're trying to keep a specific salinity in your tank, only replace the amount that you remove during water changes.

So should you use salt in your aquarium? That's a decision that only you can make for yourself. Consider the fish you are keeping, what their natural environment is like, what your water source already has in it, and any other factors that might otherwise be affecting your tank. There is certainly a place for salt within the realm of freshwater aquariums, but it's not necessarily something that every tank needs or wants.

Dissolved Gases

When it comes to the gases that are present in water, in general they tend to be the same as the gases that are present in the atmosphere. The biggest difference, though, is that gas exchange between the water and the air can be limited by a few different variables.

In the atmosphere, any gas that is removed is almost instantaneously replaced. When you breathe in oxygen and exhale carbon dioxide, the oxygen that was immediately in front of your face is instantaneously replaced. This is good because it means you won't suffocate by using up all of the oxygen around you (provided you're not in a sealed room or box, at least). It would take a significant amount of effort to alter the composition of the atmosphere around you.

THE DEBATE ON "AGING" WATER

There is a bit of a debate between aquarium owners about what it means to "age" water and if it's important or even beneficial to do.

The concept of aging water comes from the days when water treatment centers used chlorine gas to treat water. By letting water sit in an open container for a day or two, that chlorine gas would dissipate from the water making it safe for fish. Many aquarists aren't aware that they are much more likely to have to worry about chloramine, which doesn't evaporate nearly as quickly, though. If we are already using a dechlorinator to deal with chloramine, is there any reason to still consider aging your aquarium water?

Possibly. Chlorine is not the only gas dissolved in water. Sometimes, the water in your pipes has been pressurized, increasing the amount of various gases that are present. This can potentially create conditions where there is too much carbon dioxide in your water. Excess carbon dioxide can suffocate your fish in addition to significantly lowering the pH of your water. Aging your water can allow the ratio of gases in your water to stabilize in equilibrium with the atmosphere, eliminating the risk of excess carbon dioxide.

But is it necessary to do this? That's where the debate comes in. Aeration is the best way to speed up the diffusion of gases into and out of water, and strong enough aeration can likely mix enough oxygen into the water to not worry about it almost instantaneously. And often, the process of pouring water into your tank to fill it up (not to mention any other devices like filters, air pumps, and powerheads that may be running) will probably be enough aeration.

There are also aquarists who will argue that the pH swings that are the result of temporary changes in carbon dioxide levels are not harmful to fish. Many heavily planted aquariums that run CO_2 supplementation during the day can experience huge pH swings between day when carbon dioxide is being added and night when it's turned off. If you think about the possibility that the main culprit behind pH shock is actually osmotic shock from significantly different TDS levels, this argument makes a lot of sense.

So is aging your water important? It certainly won't hurt to do, even if it's not completely necessary. This question is a topic that will likely never have a definitive answer, so perhaps try experimenting yourself to see if you can tell a difference with aged or unaged water. Or just play it safe and age it anyway. The decision is yours.

It's a different story when you're talking about the gases that are dissolved in water, though. Different variables can alter the total amount of gas that water can hold. For example, high TDS water (such as seawater) cannot hold as much gas as low TDS water. Similarly, hot water doesn't hold as much gas as cold water.

The gases that are present in the atmosphere (nitrogen, oxygen, carbon dioxide, etc.) are constantly diffusing into and out of the water, trying to reach equilibrium. Unfortunately, it can take a while for this diffusion to happen. In tanks with a small amount of surface area, such as column tanks, it will take longer for this diffusion to occur. In tanks with more aeration, such as an air stone or a filter that vigorously stirs up the water, diffusion happens much quicker.

Dissolved Oxygen

All animals need oxygen in order to survive, and fish are no different. Fish are biologically designed to be able to extract free oxygen (molecules of two oxygen atoms that are not bonded to anything else) from water as it passes through their gills. Therefore, it's vital to ensure that there is plenty of dissolved oxygen in your aquarium's water.

A lot of the oxygen that is present in the aquarium will be diffused in from the atmosphere. Additionally, if you have a planted aquarium, plants will release a fair amount of oxygen during photosynthesis. Through this process, they use the energy from light to break apart carbon dioxide, keeping the carbon and releasing the oxygen. However, at night when they are deprived of light this process reverses and they stop producing oxygen and start consuming it instead.

At times, there is a delicate balance going on in your aquarium where fish are taking in oxygen and releasing carbon dioxide. If you're not careful, it's possible that the fish can consume all of the available oxygen, eventually suffocating themselves.

There are a few ways to avoid this problem. Tanks that have a small amount of surface area will have less natural diffusion happening to replace lost oxygen. This is a problem with round fish bowls whose surface area decreases as you fill them up more. The type of filtration you use can have a huge effect on dissolved oxygen levels. Submerged filters (at least those that aren't operated by an air pump) don't provide much agitation to help aerate your tank. If your tank is filled up high enough, a hang on back filter's outflow may skim the surface instead of cascading into it, which will also decrease agitation and aeration.

The Effects of Temperature

Unlike mammals and birds, fish are ectothermic (commonly called "cold blooded"), meaning that they don't produce body heat, but instead absorb it from their environment. One effect of being ectothermic is that virtually all bodily functions happen at highly variable rates, determined by the temperature of their environment.

Metabolism is one such function that is directly driven by environmental temperatures. Warmer water will increase a fish's metabolism while colder temperatures slow it down. This in turn affects both respiration and digestion.

In warmer water, the fish's respiration speeds up. They will "breathe" faster, taking in more oxygen and expelling more carbon dioxide. Additionally, in warmer water fish will eat more, digest their food faster, and release more waste. This can cause problems if your tank doesn't have the capacity to break down ammonia quickly enough.

The potential problems from the increase in respiration in warmer water is compounded by another characteristic of water – warmer water holds less oxygen than cooler water. One of the potential problems you are faced with if trying to keep cool water fish in tropical tanks is that it can be hard to ensure that there is enough oxygen for those fish. Similarly, if the natural dissolved oxygen levels are only narrowly capable of supporting the fish in your tank, you may have problems if you increase the temperature of your aquarium. If you are planning on keeping a warmer tank, consider adding extra aeration such as an air pump to your aquarium.

The Cycle

Perhaps the most important concepts when understanding the science of an aquarium is having a strong understanding of how the waste that fish produce (ammonia) is broken down and detoxified in the aquarium. This process, called The Cycle, is so important that it warrants its own chapter, so continue to Chapter 3 to learn more.

3 THE CYCLE

Out of every topic that a fish keeper should be aware of, perhaps none is more important than the nitrogen cycle. The detoxification and removal of nitrogenous waste is vital to the health of your fish and the success of your aquarium. The most common problem a new aquarist faces is adding too many fish too quickly. Until your aquarium has had a chance to complete its cycle, you should avoid adding too many (or any, depending on your personal philosophy) fish to your tank. But what is the cycle, where does this waste come from, and how do you handle it?

Problems with a Closed System

As we learned in the Science of Aquariums chapter, aquariums are closed systems. This means that every time you feed your fish, the nutrients in that food are going to stay in the aquarium until you physically remove them. It may undergo reactions to change its form, but very little of what you put into the aquarium will be able to leave it without your help.

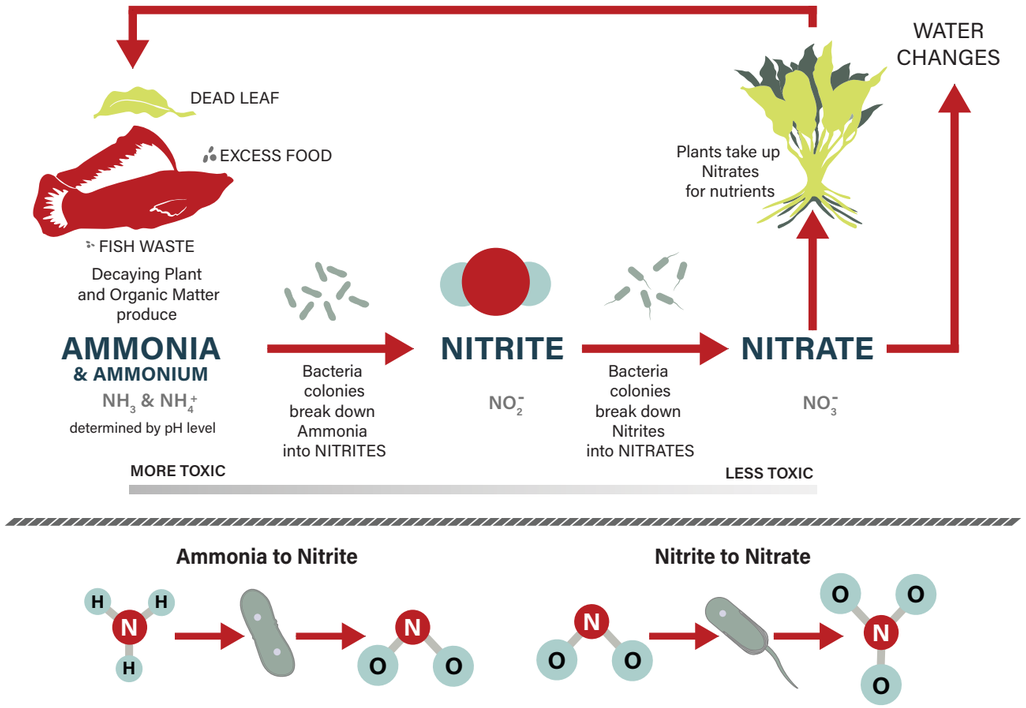
While you obviously have to continue to feed your fish, the tradeoff is that the waste your fish produces is toxic and has to be dealt with. Most people won't have the option or resources of setting up their tank to continually circulate new, clean water into it, so we have to find other solutions. And that's where the cycle comes into play.

The Nitrogen Cycle

Put shortly, the cycle is the process by which nitrogenous waste is detoxified and eventually removed from the aquarium. The primary nitrogen source to be concerned about is ammonia (or ammonium, depending on the pH of the aquarium). Over time, this ammonia is converted into nitrite and then eventually nitrate.

Ammonia and nitrite are both highly toxic to the fish in your aquarium. Nitrate is relatively harmless until it builds up to very high levels.

THE NITROGEN CYCLE



Ammonia

Virtually anything organic in an aquarium will release ammonia. Whenever you feed your fish, any uneaten food will rot and release ammonia. As your fish digest food, they release waste in the form of ***ammonia***. If you have plants, any leaves that die and decompose become sources of ammonia. Any fish that dies and is not promptly removed releases ammonia.

Ammonia is highly toxic to fish. Even relatively low concentrations of ammonia can damage a number of different cells and tissues in fish (particularly their gills), impair their growth, make them more susceptible to illness, and eventually kill the fish living in your aquarium. Fortunately, nature has developed a way to eliminate ammonia in the form of nitrifying bacteria, generally referred to in the aquarium hobby as ***beneficial bacteria.***

When you fill up an aquarium and introduce some sort of ammonia to the water, colonies of these beneficial bacteria begin to grow and develop. These colonies will use ammonia as a food source, converting it into nitrites. While it can take a while for the colonies to grow to a sufficient size, eventually (given enough surface area to colonize on) they will grow to the point that they can remove a steady supply of ammonia as quickly as it can be produced.

Nitrites

As the first colonies of beneficial bacteria begin growing and using ammonia, they release ***nitrite*** (NO_2^-) into the aquarium. Unfortunately, nitrite is almost as toxic as ammonia. Nitrite is easily taken in by fish, where it reacts with the hemoglobin in their blood. When this happens, it reduces the ability of the blood to carry oxygen. At low levels, nitrite will stunt the fish's growth. At high enough levels, the fish's blood is not able to carry enough oxygen for its cells to survive, resulting in massive tissue death and eventually the death of the fish.

However, like ammonia, more colonies of bacteria will develop that consume these nitrites. As these bacteria consume nitrite, it is then converted into nitrate.

Nitrate

While it's not completely harmless, Nitrate (NO_3^-) is far less toxic than either ammonia or nitrite. Nitrate can cause problems by inhibiting the use of certain substances (such as vitamins), stunting fish growth, and generally increasing stress in fish (which in turn suppresses their immune systems and leaves them more vulnerable to disease). Fortunately, though, many fish can handle relatively high levels of nitrates with only minimal harm.

Removing Nitrates

The problem with nitrates is that while beneficial bacteria can quickly and readily convert both ammonia and nitrite, nitrate conversion doesn't really happen in freshwater aquariums. A small amount of nitrite will be converted to nitrogen gas, but it's done slowly enough to not be particularly meaningful. This results in nitrates continually rising unless the aquarist takes some special effort to remove it.

The most common method for reducing the buildup of nitrates in the aquarium is the standard water change. By performing partial water changes, you can instantly remove a portion of the nitrates that has built up. Water changes also have the added benefit of eliminating other pollutants that may build up as well as replenishing minerals and other necessary substances.

In planted aquariums, nitrate will be used as a primary food source for the plants. Depending on the amount of plants that you have in your tank, they may even completely eliminate all of the nitrates being produced in the aquarium. However, this doesn't eliminate the need for water changes, as there are more benefits than just nitrate removal.

Similarly, nitrate will be readily used by most types of algae. If you are having uncontrollable algae growth in your tank, look for ways to reduce or eliminate the nitrates in your tank.

There are certain types of anaerobic bacteria, particularly marine species, that can convert nitrate into nitrogen gas, which is then released from the water into the atmosphere. While there's not a particularly effective method of achieving this in freshwater tanks, it's vital for success with marine fish that are much more sensitive to nitrates. Having an adequate amount of live rock allows colonies to grow large enough to convert most or all of the nitrate that will be produced.

WHERE DOES YOUR BENEFICIAL BACTERIA LIVE?

As we'll see, the beneficial bacteria that colonize your aquarium play a vital role in ensuring the health of your fish. But where in the tank do they live? On every surface in your aquarium. From the glass sides of your tank to the substrate to the plants and decorations you choose, they are everywhere.

The tank by itself, even if it's heavily decorated, likely doesn't have enough surface area to support a large enough colony of bacteria to detoxify your tank. Additionally, the bacteria can only convert what they come into contact with, so it's going to take a long time for ammonia in the middle of the tank to come into contact with any beneficial bacteria. This is where filters come in.

Regardless of what filtration method you use, whether it's a hang on back filter, sponge filter, sump, canister, or something else, there are a couple of different roles the filter will play in helping out the beneficial bacteria colonies.

The first is that the filtration media, typically some sort of sponge or other synthetic media, is going to have an extraordinarily large amount of surface area for the bacteria to colonize, increasing the total amount of bacteria in your tank. Additionally, all filters work by drawing water through them. Provided the pump is strong enough for your tank, this circulation will ensure that all of the water in your tank will come into contact with the bacteria colonies in your filter media, typically at least several times per hour.

AMMONIA VS. AMMONIUM

There are actually two different forms that ammonia can come in: ammonia (**NH_3**) and ammonium (**NH_4^+**). Of the two forms, ammonia is much more toxic than the relatively non-toxic ammonium and is the molecule that will most likely damage or kill fish.

Ammonia and ammonium readily convert from one form to the other, meaning that you will likely never have only one or the other. The exact proportion of ammonia to ammonium that will be present is largely determined by the pH in your aquarium. The hydrogen ions in acidic water will bind to ammonia (NH3) to form ammonium (NH4+). Thus, the higher your pH the more ammonia you have while lower pH conditions will have more ammonium.

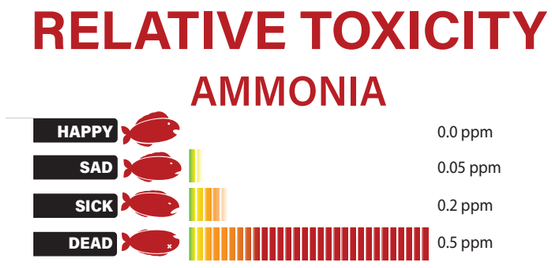
Below a pH of about 6.0, most or all of the ammonia will become ammonium. While it's good for your fish that ammonium is relatively harmless, the problem is that your beneficial bacteria is unable to consume it. Thus, it's going to continue to build up in your aquarium. The problem is going to arise if you perform a water change or add something to your aquarium that raises the pH of the water. The built up ammonium will convert back to ammonia, and without a healthy, thriving beneficial bacteria colony you're going to quickly end up with dangerous levels of ammonia.

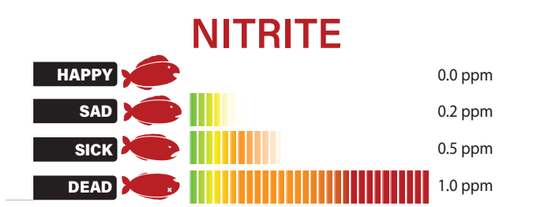
Avoiding Nitrates

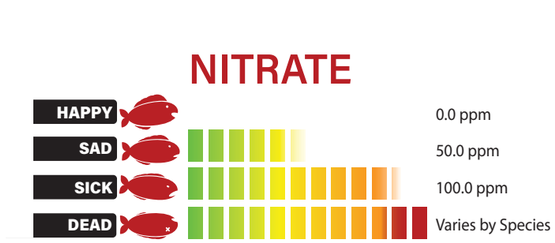
While there are methods to remove nitrates that have built up in an aquarium, it is far better to avoid having them build up in the first place.

Don't overstock your aquarium. The more fish you have, the more nitrogenous waste will be produced. If you overfeed your fish, you're going to end up with more nitrate building up in your aquarium. Carefully monitor the health of your aquarium's inhabitants so you don't end up with any fish dying and decomposing, releasing large amounts of ammonia (and ultimately nitrate) into the aquarium.

Even if you have a strong maintenance routine that can keep up with removing the nitrate being produced, it's better to stock and feed a little bit lighter in order to give some buffer room in the case of an emergency.







Cycling Your Aquarium

Tracking Cycle Progression

Knowing the biological processes involved in the nitrogen cycle doesn't do much good if you can't apply that knowledge to setting up your aquarium and don't have a way to know how your cycle is progressing. Monitoring and tracking the progress of your cycle will let you know when it is safe to add fish.

Test Kits

The only way to track the progress of the cycle is to test the water and measure how much ammonia, nitrite, and nitrate are present. Generally speaking, there are two types of test kits available: those that use paper strips and those that use drops.

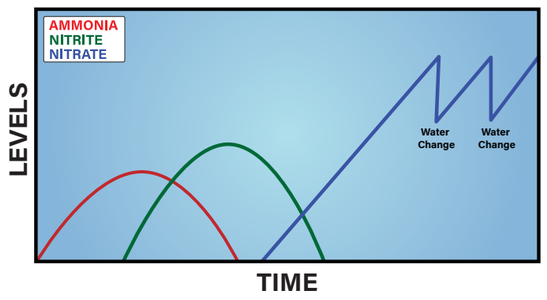
Of the two, test strips are often easier to use. You simply dip the strip into the water, wait for the strip to change colors, and then compare those colors to the guide. The problem with test strips is that they are often less reliable and are prone to giving false readings.

Test kits that use drops are typically more accurate and reliable than test strips, but require a bit more care in using. You must add a specific amount of aquarium water to a tube or vial, add a certain number of drops to the water, and compare the color of the water to the guide. There is room for user error if you use the wrong amount of water or drops. Certain test kits must be shaken well before using and may require a (sometime substantial) wait between adding drops and the chemical reactions changing the water to the correct color. But if you follow the directions properly, you will get much better results.

Knowing Where In the Cycle You Are

When you test your water, you can keep a log and track exactly where in the cycle you are.

In general terms, the first thing you will see is a rise in the ammonia levels. Eventually, the ammonia level will start to drop and the nitrite will start to rise. Some time later, the nitrite will fall again and nitrate will rise. When both ammonia and nitrite have reached zero, you know that the tank is cycled.



How high the ammonia and nitrite levels will reach depends on how much ammonia is being introduced and how large your initial colony of beneficial bacteria is. The total length of time that it takes for the cycle to complete can be highly variable, ranging anywhere from a few days to a few months. The larger the starter colony of beneficial bacteria, the faster the cycle will happen. Factors such as temperature and water chemistry can influence the speed of the cycle. How much ammonia is present can also affect the speed, with too much ammonia stalling or stopping the cycle process entirely.

On average, the beneficial bacteria colony size will be able to roughly double each day. Once your tank is fully cycled, if you lose half of your bacteria colony (for example, by replacing filtration media) or double the amount of ammonia being introduced to your aquarium (for example, by adding new fish), equilibrium should be reached again in about a day.

However, it is possible to create conditions in a cycled tank where you have to wait for another cycle to occur. Certain medications can kill a large portion of your beneficial bacteria, forcing a new cycle. Performing a particularly heavy cleaning that removes a significant amount of bacteria at the same time you add a large number of fish will overload the remaining bacteria, requiring you to wait for another cycle to happen.

Cycling With Fish

The traditional method of cycling involves adding one or two small, hardy fish to the aquarium to start producing ammonia. Between feeding the fish and the fish's normal waste production, ammonia gets introduced and beneficial bacteria start to grow.

Fish such as goldfish, danios, barbs, and damsels have long been the most common options for cycling a new aquarium because they are hardy enough to withstand many of the toxic effects of the nitrogenous waste.

Many people, though, have shifted away from adding live fish to start the cycle. Even hardy fish that are very lightly stocked will be exposed to some amount of ammonia and nitrite and many people will argue that you shouldn't expose them to these harmful chemicals at all. It is also very easy to add too many fish to the uncycled aquarium to begin with, creating dangerous conditions for your fish and potentially causing many unnecessary problems for both the short and long term.

If you are going to cycle with fish, make sure to only add one or two fish at a time, allowing the beneficial bacteria colonies to develop until the tank is fully cycled before adding more fish. Watch your ammonia and nitrite levels carefully and perform water changes if they start rising too high. Once you have completed the initial cycle, continue to only add small numbers of fish each time so that the bacteria can keep up with the increasing bioload without ever having too much ammonia build up.

Fishless Cycles

More and more people are choosing to use methods to cycle their aquarium that don't involve risking the health of any fish. The bottom line is that in order to get a cycle going, you have to introduce a source of ammonia. There are a few different sources you can choose.

Some people will start with some sort of organic matter. You can add fish food to the aquarium, allowing it to decompose and release ammonia. Some people will use an uncooked shrimp in the same way. The downside of this method is that it can take longer (as you have to wait for the decomposition to happen) and there is little to no control over how much ammonia you are introducing to the aquarium.

A better method is to use pure ammonia that can be found as a cleaning solution. You want to be careful to choose a solution that contains only ammonia and water. Avoid any that are supplemented with additional chemicals or fragrances.

When using ammonia, start with a small amount (just a few drops) and use your test kit to measure how much is being added. Depending on how large of a bacteria colony you want, add enough ammonia to bring the concentration between 2 and 5 parts per million. 2ppm will be sufficient for a somewhat lightly stocked aquarium, while 5ppm should allow you to fully stock it all at once.

Once you've learned how much to add to bring the concentration of ammonia where you want it, you will need to test your aquarium regularly to monitor the progress of your cycle. When the ammonia begins to fall and nitrite begins to rise, keep adding ammonia daily to replenish the desired concentration.

Continue this process until you can add ammonia and have both the ammonia and nitrite levels return to zero within a day. When your bacteria colony is strong enough to accomplish this, you are ready to add fish. Perform a large enough water change to bring your nitrates back down. Congratulations, your aquarium is ready!

Speeding Up the Cycle

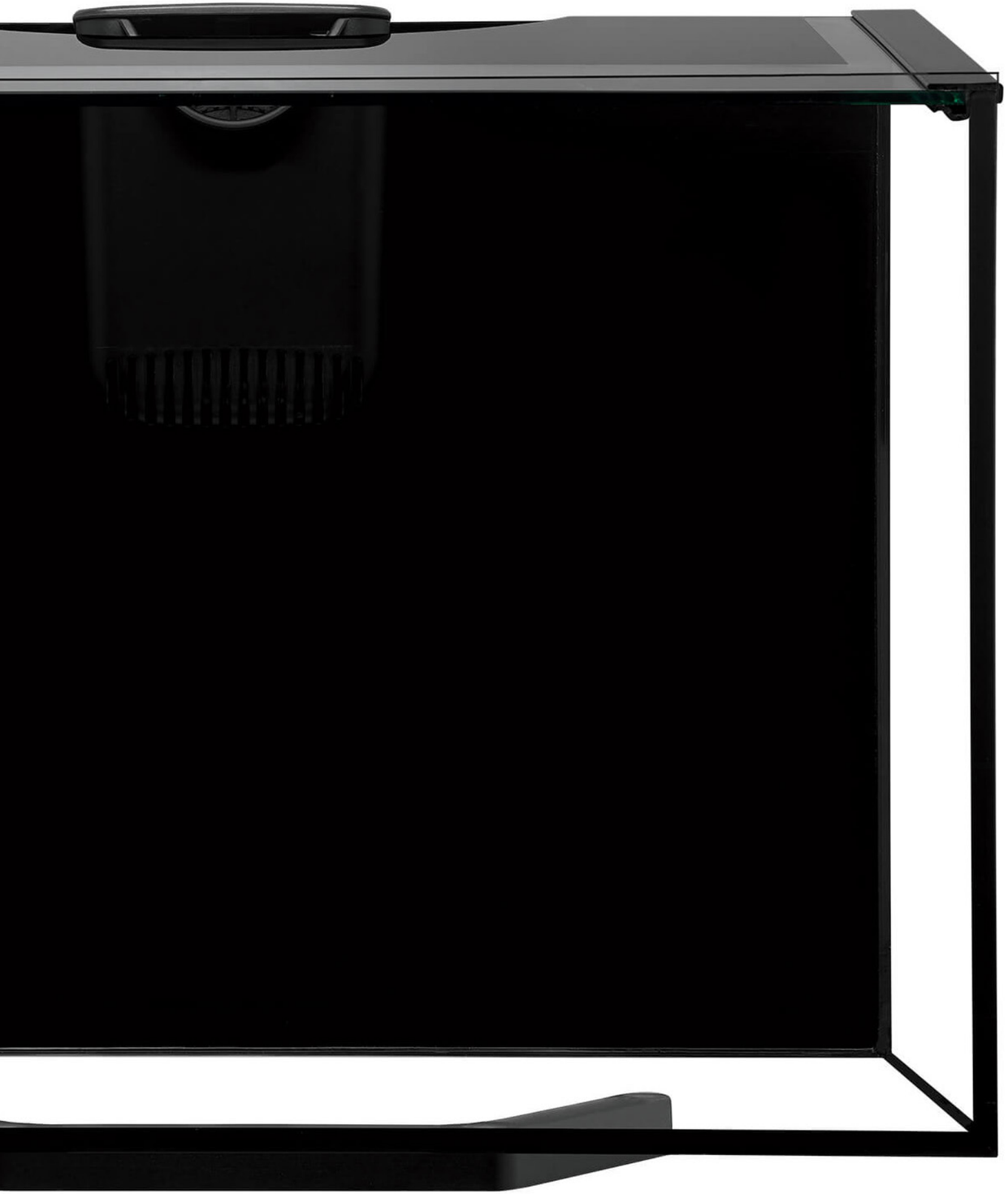
As with many parts of fishkeeping, success largely comes down to patience. However, many people don't want to wait, so a number of products and techniques have been developed that are reported to speed up the cycle process.

If you want the absolute fastest way to get a new aquarium cycled, the best way is to introduce a sizeable beneficial bacteria colony from an already established aquarium. The most common method would be to place a filter pad that has been in an established aquarium into your own filter. If the established tank uses an undergravel filter, you can take a cup or two of the gravel from that tank, place it in a mesh bag, and add it to your filter. These methods have the potential to instantly cycle your tank, but they also run the risk of accidentally introducing diseases into your aquarium.

There are a number of commercially bottled products that claim to introduce enough bacteria to significantly increase the speed of the cycle. People have had very mixed experiences with these products. While they likely were all bottled with good amounts of beneficial bacteria in them, additional factors such as how long they have been bottled and what sort of temperatures they have been exposed to can affect the health of the original colonies, potentially even killing all of the bacteria in the bottle. There is no way to know how healthy the bacteria contained truly is.

Aside from these additives, you can try to set up your aquarium to encourage faster growth of the beneficial bacteria colonies. Try to keep the temperature of your aquarium between 80 and 85 degrees and the pH around 7.5. Nitrifying bacteria growth will slow down or stop in acidic conditions or when the pH is above around 8.0. Additionally, using an air pump to increase the amount of dissolved oxygen can also help speed up their growth.

Established Bio spheres, placed in a canister filter can help cycle your aquarium.



Aqueon Ascent 10 Gallon Frameless Aquarium

4 THE EQUIPMENT

When you're planning on starting an aquarium, the equipment you choose can greatly affect your chances of success. When you're brand new, walking into a well-stocked fish store can be overwhelming. Everywhere you turn there are different boxes, each claiming to solve a problem you don't even know you're going to have.

Just take a deep breath and relax. All of the different equipment you see has its place, but many of them you likely won't need. As you get deeper in the hobby you may find that situations arise where you want to try something new, or you may develop preferences that steer you towards certain items. But when you're just starting out, there are only a few pieces of equipment that you will absolutely need and only a few more that you may want to think about adding on.

Equipment Checklist

Major Equipment:

- ❑ Tank
- ❑ Stand
- ❑ Filter
- ❑ Heater
- ❑ Substrate
- ❑ Lights
- ❑ Powerheads and air pumps

Other Supplies:

- ❑ Water treatment materials – Dechlorinator, pH buffers, aquarium salt, etc
- ❑ Test kits – At least pH, ammonia, nitrite, nitrate
- ❑ Hardscape and decorations
- ❑ Plants and plant equipment (see Chapter 9 for more information)
- ❑ Aquarium background
- ❑ Gravel siphon, algae scrubber, and other cleaning supplies
- ❑ Miscellaneous odds and ends - Air tubing, checkvalves for air tubing, etc

Tanks

If you're going to set up an aquarium, you need a tank. Most stores are going to have a wide variety of tanks in all different shapes and sizes. There are cubes, rectangles, cylinders, tanks with the front pane bowed out, tanks where the front pane is shaped like a wave, tanks with angled fronts or rounded edges. Some tanks are glass, some tanks are acrylic. Some tanks have plastic rims around the edges and others don't. How do you make a decision between all of these?

The first thing you should think about is what size of an aquarium you want. With first aquariums, it's tempting to go small. You may want to "dip your toes in the water" to see if fish keeping is the right hobby for you. This is understandable. Unfortunately, it also has a tendency to lead to significant problems down the road.

It's true that small tanks are cheaper, lighter and easier to move, and you don't have to spend as much on the other equipment. But it's also true that smaller tanks are harder to care for than larger tanks. The more water you have, the more stable it's going to be. Small tanks can be a challenge to maintain stable water parameters, and it doesn't take many fish to overpollute your tank.

Additionally, large tanks give you more options on what fish you keep than a small tank does. You're only going to be able to keep a few fish in a 5 or 10 gallon aquarium, while you might be able to put a whole school of fish into a 55 gallon. If you're just starting out, this may not seem like much of a concern, but it won't take long for you to reach the point where you want to add another fish and realize that you just can't fit anything else in your tank. ***The best choice you can make is to choose the largest tank that your space and budget will allow.***

The next choice you have to face is what material you want your tank to be made from. Almost every aquarium is made from either glass or acrylic, and the good news is that neither material is objectively better than the other. They both have their strengths and weaknesses, so you can generally choose which tank you like better.

Historically, glass has been the material of choice for aquariums. Glass is very clear and highly resistant to scratching or other damage that makes it more difficult to see into the aquarium. However, if glass does get scratched, it's a lot harder to remove the scratches. There's also always the risk of glass breaking if something hits it with enough force. Aesthetically, glass can be found with or without rims, giving you a variety of visual options. Traditionally, glass tanks all had flat sides, but companies have recently begun manufacturing them with curved sides as well. This gives you additional options to fit your personal style.

One potential problem you might want to be aware of is the potential for the silicone adhesive that holds the multiple panes of glass in an aquarium together to stop holding the glass together. It's much less likely for you to have an issue with busting a seam in your aquarium than it used to be, but the possibility is nevertheless still there. Acrylic tanks are manufactured in a way that chemically bonds the sides together, essentially making one solid piece. It is exceedingly rare for an acrylic tank to break along a seam.

Acrylic is much lighter than glass, making larger tanks easier to handle. While acrylic can offer comparable clarity, it is much easier to scratch than glass, which can lead to a cloudy appearance. This is particularly problematic if you use the wrong algae scrubber, essentially sanding the surface of your aquarium. However, if you do end up with scratches, it is easier (though still not trivial) to buff the scratches out of the tank, restoring it to its original clarity. Acrylic is less likely to break than glass and can also be found in any shape you may want.

Aside from size and material, unless you are choosing an all in one aquarium (that includes a built in filtration system), all of the other differences will be cosmetic, so you can choose whatever style you prefer.

Stands

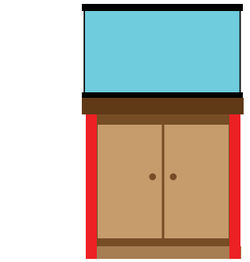
Unless your aquarium is very small (think 10 gallons are less), you should plan on putting it on top of a stand designed to hold an aquarium. For smaller tanks, you can probably get away putting it onto some piece of furniture or a different type of support, but even then it wouldn't be a bad idea to look for a dedicated stand.

Fish tanks are not light. Once you add substrate, decorations, additional equipment, and fill it with water, you can estimate that your aquarium will weigh approximately ten pounds per gallon. Your 10 gallon aquarium will likely be around 100 pounds once you fill it up. A 55 gallon will weigh over 500 pounds. You should think very carefully about whether or not the piece of furniture you are thinking about using is strong enough to support that amount of weight in the first place.

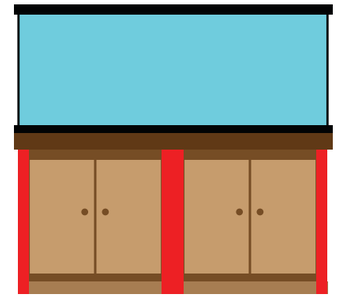
But the weight of your aquarium is not the only factor you should be concerned about. If you put the aquarium onto a table that's not completely stable, you may end up in a situation where the tank wobbles and is prone to falling over. If the surface of the table isn't completely level, you may have unusual pressure being exerted onto certain sides of the aquarium, increasing the chance of having a side or a seam in the tank break.

While there's a low chance of a catastrophic failure for an aquarium, that chance still exists. Cleaning up a few dozen (or more) gallons of water is not going to be fun regardless of the scenario. But if your tank is sitting on a dresser filled with clothes or a valuable table, the water could damage other possessions that would have been safe if you had just used an aquarium stand.

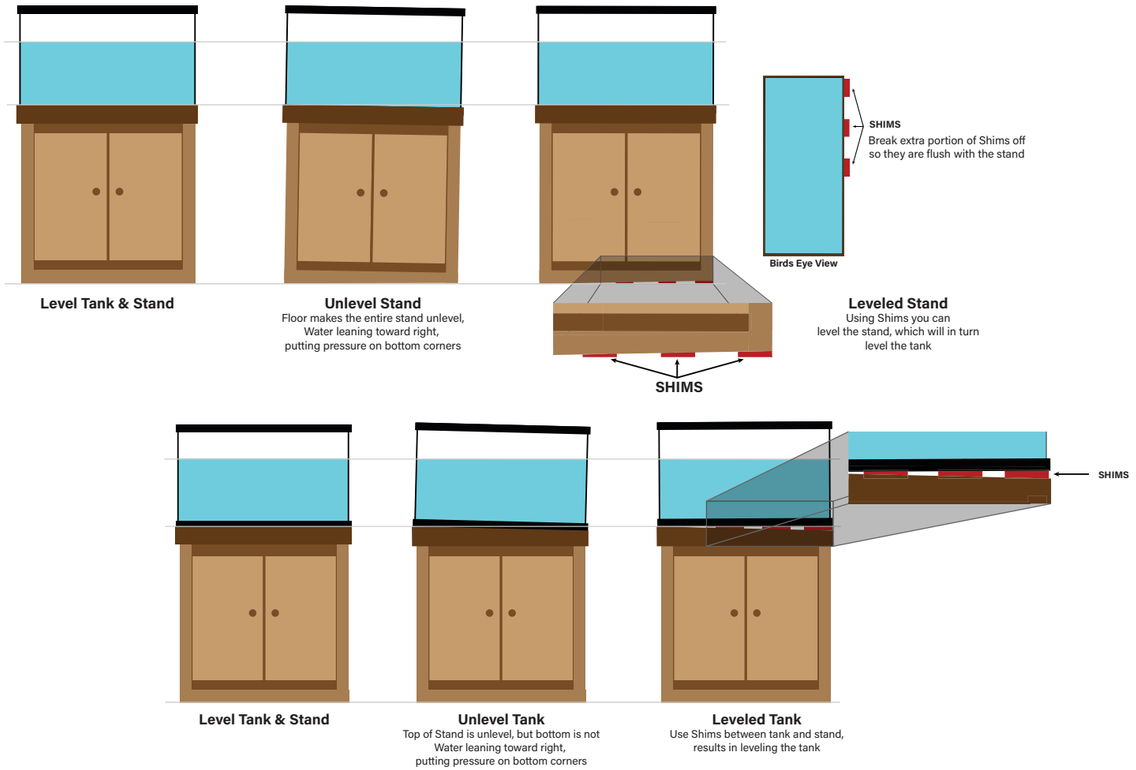
Tank Stands
Support and Leveling



Regular Tank & Stand
red highlights show weight bearing supports



Large Tank & Stand
red highlights show weight bearing supports



Filtration

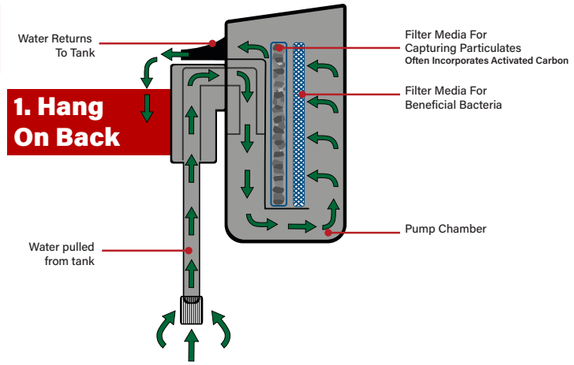
Filtration is a necessity in most aquariums and beneficial in all aquariums. If you have a betta or a common goldfish, you may be able to get away without a filter, just performing frequent water changes, but even these fish will do better when you use a filter to help detoxify the harmful nitrogenous waste. There have been many filter designs that have gained popularity over the years. You can set up a successful tank with any of them if you plan right.

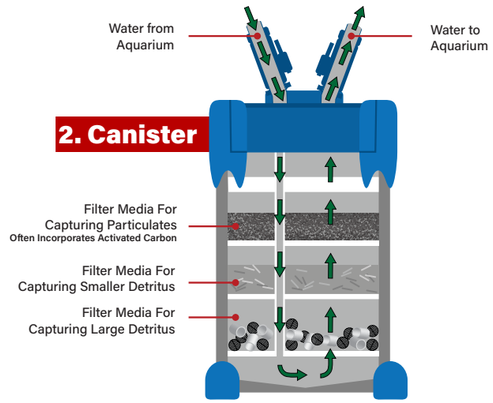
There are three primary forms of filtration that are used to purify the water in aquariums. ***Biological filtration*** is what happens when you foster the beneficial bacteria colonies that break down nitrogenous waste (see Chapter 3 for more information). Some sort of filtration media such as a sponge or ceramic rings is used to give surface area for your beneficial bacteria to colonize on. ***Mechanical filtration*** uses a filter cartridge of a certain fineness to physically trap solid materials so that you can physically remove them from the water. The mechanical filter may be a substance along the lines of a sponge, foam, or a cloth that the water can pass through. Mechanical filters should be regularly cleaned or replaced as the waste trapped by them will break down over time into pieces small enough to no longer be trapped by the filter. Finally, ***chemical filtration*** uses activated carbon to pull chemical substances out of the water column. These will pull out substances such as medications and the tannins released by driftwood. Eventually, this carbon will "fill up" and be unable to absorb any additional chemicals, requiring you to replace it. Every filter being made is designed to utilize one or more of these filtration methods.

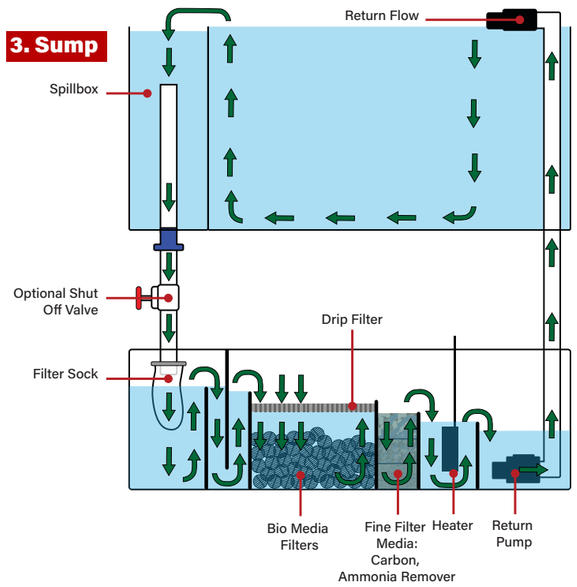
1. Hang on Back (HOB) Filters

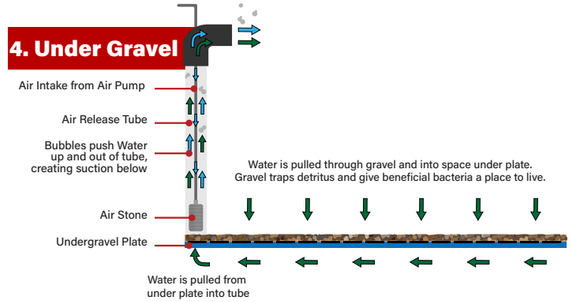
Perhaps the most popular type of mechanical filter on the market now, particularly for smaller tanks, is the ***hang on back filter***. These work by drawing water up an intake tube, running it through one or more types of filter media (often some sort of cartridge), and then overflowing back into the aquarium. You can find hang on back filters that utilize all three filtration methods and that range from highly effective to fairly mediocre. Many of them use proprietary cartridges for mechanical filtration that you will need to replace on a regular basis, though the better designs will also have some sort of biological filtration media that should never be replaced.

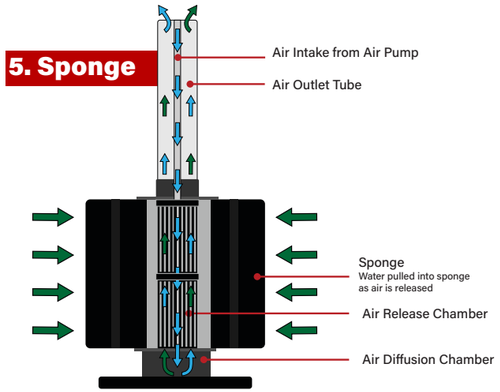
Most hang on back filters are quite reliable and don't have problems with breaking down. Depending on the model, if there is a problem it may be fairly easy to replace a part and fix, or it may require you to purchase a whole new filter unit. If there is one risk you should be aware of, it's that there is a possibility that if a filter cartridge gets too gunked up it may cause some water to overflow the back side of the filter and onto your floor, though most are designed to prevent this.

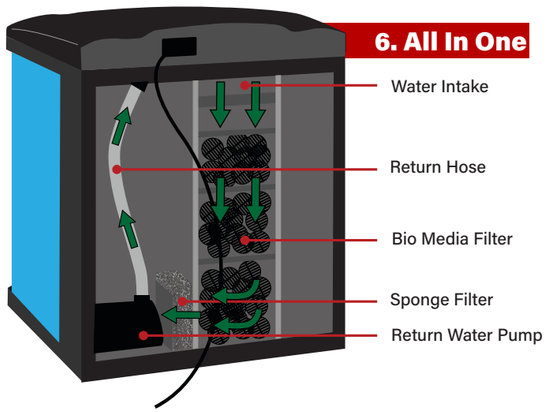












2. Canister Filters

Canister filters are another popular design that tend to get used in tanks that are slightly larger. Canisters pull water out of the tank, through a hose, into an enclosed shell that houses all of the filter media, through another hose and back into the tank. Canister filters have some tremendous advantages such as being able to offer more filtration power, being able to have the intake and output on opposite sides of the tank (creating a steady current), and often offering a more discrete profile since the main filter is hidden in the cabinet under the tank.

However, they can take more effort to open up and clean the filtration media and many models can be difficult to start the flow of water into.

3. Sumps

For very large tanks, many keepers prefer a ***sump system*** for their filtration. Sumps can be more complicated to set up, typically requiring you to drill one or more holes in your aquarium and attaching plumbing to route the water. However, for large tanks they can be the most effective form of filtration and when set up correctly can hide almost all of the equipment from being seen in the main display tank.

Sumps operate by having an overflow that the water drains down and into another tank waiting below. The bottom sump tank will normally feature several "chambers" that house the various filtration media. The last chamber will house a water pump that returns the water to the main display tank. Because of the flexibility of a sump, it can be scaled up to any size you need, allowing you to get enough filtration regardless of how large your aquarium is. They also keep the water line of your display tank at a consistent level, as the water will stay at the same level as the overflow's intake for as long as the pump is running.

The downside to sumps is that they are generally more complicated to set up. There are some tanks that come paired with a manufactured sump, but often there is going to be a bit of custom building for a sump system. You're also going to have to make sure that holes are drilled into the glass to connect the tank to the sump. With a sump, your setup will have more water in it be-

cause you have to have enough water to fill the display tank plus enough to overflow into the sump to a depth that the return pump can pump it back up. But you also have to be careful with how much water you have, as there will always be a certain amount of water that's in neither the display tank nor the sump because it's traveling through the plumbing. If you lose power, this extra water can cause the sump to overflow.

4. Under Gravel Filters

One of the older filtration methods that can still be found are ***under gravel filters.*** These use some sort of platform with small holes in it that sits underneath the substrate, creating a chamber of water under the gravel. There will be a larger hole with a pipe into which an air hose with an air stone is inserted. As the air bubbles from the air stone rise, they pull the water from under the platform up, resulting in water from the tank flowing through the gravel to replace it.

Under gravel filters work by turning your entire bed of substrate into one large biological filter. Waste gets trapped in the gravel where it breaks down and beneficial bacteria denitrify it. These can be quite effective, but they can also be somewhat fragile. It's easy when cleaning to siphon out the gravel to the point that the majority of the beneficial bacteria is removed. There is no way to incorporate true mechanical filtration and there is only a limited amount of chemical filtration you can set up. But despite these limitations, under gravel filters were the standard for many years and keepers can still be successful with them

5. Sponge Filters

Many aquarists like to use ***sponge filters,*** especially when keeping fry or other fish that need very gentle filtration. In effect they work very similarly to under gravel filters, using flow (typically driven by an air stone) to pull water through a pipe. The difference is that they use a sponge wrapped around the pipe instead of pulling the water through the gravel. The big advantage for sponge filters is that you don't have to worry about any fish getting pulled through the filter media and being killed. They can be highly effective biological filters and you don't have to worry about killing off the bacteria colonies when you siphon out the tank. In fact, sponge filters are often used in breeding tanks that are kept without any substrate at all.

6. All In Ones

A number of all in one aquariums are being manufactured that include filtration built into the tank. Most of these use a system similar to what is found in sumps, with an overflow for the water that leads through filtration media and eventually to a return pump. Most of these seem to be fairly good, but you are limited in how much filtration power you can have. Whereas with other aquariums you can add more filtration, with an all in one you're stuck with how the tank is made.

7. Specialty Filters

There are a variety of other filters available, but they are generally more specialized. Wet/dry filters use specialized media (typically plastic "balls" or special ceramic media) that water is trickled over. These are often integrated into sumps, but there are also a number of all in one aquariums that have a similar system built in. Wet/dry filters can be highly effective biological filters.

Another specialized piece of filtration equipment is the UV sterilizer. These pass water through an enclosed housing containing a UVC light. UVC is an extraordinarily damaging form of UV radiation that will destroy the cells of almost any organism exposed to it. This makes UV sterilizers a great tool for killing free floating bacteria and parasites that may otherwise infect your fish. They're also great for getting rid of green water problems, which is caused by free floating algae in your aquarium. The downside is that they can only sterilize the water that flows through them (making them ineffective for algae or pathogens that are attached to surfaces) and the bulb has to be changed at least twice a year.

All of the filtration methods have certain strengths and weaknesses, but they can and are all used quite successfully. Which filtration method you use often comes down to what size tank you have and your personal preferences.

Heaters

Whether or not you need a heater is going to be determined by what fish you want to keep. The majority of the fish that are kept in aquariums come from tropical environments and need temperatures ranging from the mid 70's to the low 80's, which is going to require adding a heater to your tank. Certain fish, such as goldfish and white clouds, are natively from cooler environments and are ideally kept in the 60's. For these fish, you probably won't need to have a heater.

Generally speaking, there are two styles of aquarium heater you can choose from. Lower end heaters will hang from the back of your aquarium. The concern with these is that there is a certain level that your water will need to stay above. If the water level drops below this line, it's possible for the glass tube to overheat and crack, breaking your heater and potentially exposing your electrical components to the water.

The second style of heater is fully submersible and is placed completely under the water. This eliminates the possibility of being exposed to the air and cracking. Most of the time, submersible heaters are going to be better made and more reliable than hang on back heaters, but there are always going to be exceptions to this.

All heaters are going to have a temperature control of some sort in order to allow you to dial in the precise temperature you want in your aquarium. Sometimes, the temperature control is a physical dial you will turn to increase or decrease the temperature, sometimes it's buttons on the top of the heater, and sometimes it's an electronic controller attached to the power cord. There should be some sort of a temperature gauge to indicate what temperature you've set it to, but these are notoriously unreliable. You should have an external thermometer somewhere in your aquarium so that you can always have an accurate temperature reading.

Where you place your heater is going to depend on the style of heater as well as the overall layout of your tank. You should try to position it somewhere that receives a fair amount of flow so that the warmer water can be readily distributed through the aquarium. Be careful not to have it pressed right next to another piece of equipment that might be damaged by the heater.

The tank size guidelines that are listed on the packaging is normally fairly accurate, and you want to make sure you have a strong enough heater to keep your aquarium at the correct temperature. Some people recommend using two smaller heaters instead of a single larger one to protect against malfunctions. Doing this will offer some protection against the tank overheating if the heater starts running at full power while also having a backup providing heat if one stops working.

Substrate

The substrate you choose for your aquarium, or even your lack of substrate if you decide to have a bare bottom tank, can have an enormous effect on your aquarium and the maintenance you have to do. Your substrate will change the look of your tank and potentially influence your water chemistry. Depending on the fish and plants you want to keep, you may find that certain substrates are more suitable than others.

The most obvious role that substrates play is purely aesthetic. Whether you choose bright, colorful gravel, naturalistic sand, or a minimalist bare bottom look, the overall visual effect of your aquarium is going to begin with your substrate. In this respect, there is nothing wrong with any type of substrate as long as you like what you choose.

How fine or coarse your substrate is, though, can start having an effect on your aquarium. Standard aquarium gravel is fairly consistently sized because it offers a good compromise, being neither too large nor too small. It's large enough that uneaten food, fish waste, and other detritus can fall into the gaps between the pieces and be hidden from view. It has enough surface area for beneficial bacteria to colonize. And it's small enough to be easy to stir around or run a gravel siphon through in order to clean it out.

Smaller grain substrates, such as sand and a lot of the planted aquarium substrates, will pack a lot tighter, not allowing as much waste to fall between it. Plant roots are better able to snake their way through fine substrates, helping them to anchor better. This is particularly true for very small plant species that have short root systems. One particular challenge, though, is that very fine substrates can potentially pack tight enough together to create anoxic regions, or areas where no oxygen can reach. These anoxic regions can lead to all sorts of noxious chemical compounds forming such as hydrogen sulfide that have the potential to kill your tank inhabitants. If you're keeping a fine grain substrate, you should either have animals that dig through the sand or manually stir it up regularly in order to keep all areas oxygenated.

Very large substrates such as pebbles and marbles are going to have a lot of space between the individual pieces that waste can fall into. There won't be nearly as much surface area for beneficial bacteria to grow on as with standard aquarium gravel, and the individual pieces of substrate are likely to be too large and heavily to easily clean with a siphon. But, they can be very attractive to look at. Conversely, bare bottom tanks won't have anywhere for the waste to hide, so you will have to manually clean it more often, but there will be nothing getting in your way.

Plants and animals may prefer different sized substrates. Most plants will have an easier time rooting into sand than larger substrates, although plants with more substantial root systems such as sword plants may not have as much of a problem. Certain fish, such as the Geophagus species, like to root around in sand

Aqueon Modular LED Aquarium Light

in search of food. Large gravel doesn't work well for this. Cory cats and other bottom dwelling species also generally do better with smooth, fine sands as opposed to larger, rougher gravels. The larger gaps in between the bigger substrates may allow certain fish to squeeze their way into there. This may help babies find a safe area to survive, but it may also result in you being unable to find some of your fish.

Another reason why standard aquarium gravel is so popular is that it is chemically inert and will not affect your water parameters in any way. Certain substrates, such as those made from crushed coral, aragonite, or certain types of crushed stones, can add calcium carbonate to your water, increasing the hardness and the pH of your aquarium. A number of substrates designed for planted aquariums will actually do the opposite and lower your pH. These can be great choices if that is how you want your aquarium set up, but they can also cause problems if they're incompatible with your fish choices.

One of the big things you need to think about with whatever substrate you choose is keeping it clean. For all but the largest substrates, a gravel siphon is the perfect tool for this, and you can get them in larger or smaller sizes, depending on what size aquarium you're keeping. Just start the siphoning process, letting the water flow into a sink, bucket, or drain, and dig around in the substrate with the end to pull out the detritus that has settled there. Many gravel siphons have some sort of squeeze pump or other mechanism to help you get the flow started, and some even connect to your sink to help with both pulling out and replacing the water.

Lights

Almost every aquarium is going to come with some sort of a light to go on top of it. Depending on what your goals for your aquarium are, that light may be perfectly adequate, or you may need to upgrade for a different type of light.

When it comes to your actual fish, they are largely indifferent to the light that you put on the aquarium. The benefit is mostly to help you see in your tank. Fish do best when they have a normal day/night cycle, but this can largely be established with nothing more than ambient light. Certain fish are fairly shy and reclusive and will actually be happier with less light streaming into their aquarium.

Traditional aquarium lights have used fluorescent bulbs, and you can still find a number of those available. Increasingly, more manufacturers are switching over to using LED lights in their aquarium hoods. These have the advantage of being much more energy efficient, having to be replaced far less frequently, and putting off less light (thus leading to fewer algae problems).

If you're keeping a planted tank or a reef aquarium, you probably want to look for a stronger light setup. High output fluorescent lights are very popular in planted tanks, and many reef keepers swear by metal halide fixtures. Newer high tech LEDs are appearing that are beginning to replace these traditional lights, but not all LED fixtures are created equally. You need to do careful research to make sure that your fixture will be able to support the plants or corals you want to keep.

Powerheads and Air Pumps

Not every aquarium will need a powerhead or an air pump, but they're good to know about in case you decide that you do want one.

Powerheads are essentially just water pumps that attach to the inside of your aquarium. Some will hang off the edge of your tank while others will use suction cups to stay in place. The primary purpose of powerheads is to increase the amount of current in your aquarium. They are especially important in saltwater tanks, where the fish come from environments with powerful waves moving the water around, as well as for fish that come from rivers that have strong currents.

There are a couple of additional benefits that you can introduce with powerheads. Many of them have the ability to attach a sort of external filter to them. Depending on what exactly you add on, this can be useful as a secondary biological filter or be used to "polish" the water by trapping smaller pieces of sediment that are suspended in your water. Additionally, many powerheads have what's called a venturi, which is just a hole that you can connect an airline to in order to push air into the flow from the powerhead.

Air pumps are one of those pieces of equipment that aquarists either swear are absolutely vital or think are completely unnecessary. They simply push air through an air tube, through some sort of diffuser, and into the aquarium. If you are concerned that there may not be enough dissolved oxygen in your aquarium, such as if your tank is heavily stocked or fairly warm, you might want to try using an air pump. In any case, an air pump won't hurt your aquarium.

When using an air pump, you'll need a long enough air tube to reach from the pump and into the aquarium. Air pumps are always kept outside of the aquarium, so depending on where you put it you may need a fairly lengthy tube. There are special air tubes made of CO2 resistant materials. Unless you are running a special CO2 system for planted tanks, a standard air tube will work without problem.

It's a good idea to attach a check valve to your air tube. This is a one way valve that lets the air travel from the pump to the tank but will prevent water from flowing the other way and siphoning out of your tank if your air pump turns off. Finally, you want some sort of air stone or diffuser to put on the end of your air tube inside of the aquarium. These will break up the air into small bubbles that will more efficiently dissolve into the water. There's a wide range of sizes and materials available. Larger stones are appropriate for larger aquariums and stronger air pumps. Try to choose the stone that will break up the air stream into the smallest possible bubbles.

Aqueon Circulation Pump 1650

5 THE FISH

Learning the scientific foundations of aquariums, finding the right equipment for your aquarium, thinking about the overall direction you want to go with your tank, these are all important steps in preparing to set up an aquarium. But eventually it's time for the main event: choosing fish for your tank.

There are a lot of fish in the world. There are so many different species and varieties of fish, and so much information about each one, that you could choose almost any grouping and write an entire book just on those fish. And many people have. But this is not one of those books. There's only so much space we can devote to any one topic.

Hopefully, though, this chapter can give you an overview of some things to think about when you walk into a fish store for the first time and start thinking about what you want to keep. Research the specific details of any fish you think about keeping. And of course, a good fish store with a knowledgeable staff is one of the best resources for learning about fish.

General Stocking Considerations

There are two general ways you can approach stocking your aquarium. You can either decide what kind of setup you want and then choose fish that will fit into the conditions you'll be creating, or you can choose a fish you really want and then design the tank and pick out additional tankmates from there.

You need to ensure that everything you put into your aquarium is compatible with each other as well as with the overall aquarium parameters. You want to make sure that the fish you have are not going to die from being exposed to water chemistry they can't handle, that your fish will have plenty of room in your aquarium, and that you minimize the risk of fish fighting and killing each other. It can also be helpful to think about the different behaviors fish are inclined to have and try to make sure that different roles and niches are being filled.

Water Chemistry

The most basic and straightforward consideration that you need to think about is the water chemistry of your aquarium. Is it going to be hard and high pH? Soft and acidic? Are you setting up a brackish or saltwater aquarium? Are your fish tropical fish that need warm water, or do they come from cooler environments?

"Neutral" Parameters

Probably the most common aquarium setup you can choose, the majority of home aquariums likely have fairly neutral water parameters. This is because many water treatment procedures adjust water to relatively neutral chemistry. Most of the popular freshwater fish are raised in fish farms or other aquaculture operations that have relatively neutral water chemistry, so these fish have acclimated to these conditions over multiple generations.

When we say that a tank is relatively neutral, we are normally talking about water with a pH anywhere from the mid 6's to the mid 7's and moderate water hardness. The temperature is probably going to be kept in the mid 70's to low 80's. There is generally not going to be any salt added to the aquarium. Some aquarists may add a small amount of aquarium salt, but not nearly enough to start considering it a brackish tank.

In nature, many of the slower moving rivers and streams across the Americas, Africa, and Asia have neutral water chemistry, as do a number of lakes. Most captive bred tetras, captive bred angelfish, Central and South American cichlids, barbs, gouramis, rasboras, danios, rainbowfish, plecostomus, and catfish do well with relatively neutral water chemistry.

Softwater and Blackwater Tanks

A number of rivers around the world have fairly soft water. Many (but not all) bodies of water that feature very soft water are blackwater rivers where large quantities of tannins are leeched into the water by trees, leaves, and other organic matter. While most blackwater environments are rivers (such as the Rio Negro), there are at least a couple of blackwater lakes as well.

For a softwater tank, you are going to have low pH (typically 6.0 or below) and low hardness. Because most water supplies have harder water than this, you will most likely need to take special efforts to set up a softwater aquarium. Reverse osmosis (RO), or even RO/DI, filtration can be used to strip many of the minerals from your water before adding it to your aquarium. Leaves, peat, and alder cones can be used to supply tannins to create a blackwater environment and push the pH lower.

Something to think about if you are looking at setting up an acidic softwater aquarium is that the beneficial bacteria colonies stop working once the pH drops below about 6.0. If your pH is below this, you'll need to use other methods (such as large, frequent water changes) to remove the ammonium from your aquarium.

While there are a number of fish that thrive in soft and blackwater conditions in the wild, captive bred individuals will likely best handle neutral water chemistry. Cardinal tetras, angelfish, discus, apistogramma, cory cats, and hatchetfish are all native to soft water regions. Keep in mind that even if you do get wild collected individuals, they normally travel along a long supply chain that gradually acclimates them to neutral conditions. If you want to return them to more natural soft water, spend a few weeks and do it slowly.

African Rift Lakes

The Rift Valley lakes are a series of lakes formed in East Africa as the result of the splitting of a tectonic plate. These lakes contain an enormous amount of water, combining to house an estimated 25% of the non-frozen surface freshwater on the planet. This has allowed it to become an enormous source of biodiversity. Ten percent of all fish species live in the Rift Valley.

Because of their formation in the split of a plate, they are often surrounded by sizable peaks and cliffs that funnel rainwater into the lakes. Because of this, erosion washes rocky sediments into the lakes, where they leech a number of minerals into the water. The lakes slowly drain (or don't drain at all), causing the hardness and pH of those lakes to rise. Some of the lakes can reach pH levels above 9.0 and have a higher salt concentration than the ocean.

In the aquarium trade, most of the fish that we see come from the three largest lakes in this region: Lake Malawi, Lake Tangyanika, and Lake Victoria. As a general rule of thumb, most African Rift Lake aquariums should have fairly alkaline water, a sandy substrate, and a fair amount of rockwork forming a variety of caves and crevices.

Lake Malawi

The smallest of these three lakes, Lake Malawi is nevertheless the 8th largest lake by surface area and 4th largest lake by volume in the world (assuming you consider the Caspian Sea to be a sea and not a lake). The water chemistry of Lake Malawi is moderately hard and alkaline, with the pH ranging between 7.7 and 8.5 and typical temperatures in shallow areas ranging from 75 to 85.

The most prevalent fish are cichlids, although other groups of fish can be found there as well. Depending on the estimate, there are anywhere from 700 to more than 1,000 species of cichlid in Lake Malawi. Many of the Malawi cichlids are extremely closely related, making it sometimes difficult to determine if a fish is a different species or a variant of another species. This also means that hybridization is quite prevalent. If you're wanting to avoid creating accidental hybrids, you should try to keep either a male only or a single species tank.

Malawi cichlids are largely divided into two primary groups: Haplochromines (which can be further divided into peacocks, haps, and mbuna) and tilapiines (which are relatively uncommon in the aquarium trade). Peacock cichlids, which are usually the most peaceful of the Malawi cichlids, are the various species of the *Aulonocara* genus. Haps are relatively peaceful and include a variety of genera including *Copadichromis, Dimidiochromis,* and *Protomelas* among others. Mbuna are the most aggressive Malawi cichlids with genera including (but not limited to) *Labeotropheus, Melanochromis,* and *Pseudotropheus*.

Lake Tangyanika

Lake Tangyanika is larger than Lake Malawi in both surface area and volume. There is a fairly wide range of pH across the lake, ranging from about 7.6 all the way up to 9.0 or higher. Most aquarium keepers find that keeping the pH anywhere in the low to mid 8's gives good results. Keeping water parameters stable is more important than hitting a precise number, and it can prove to be challenging to keep the pH stable and consistent at the upper end of the lake's natural range.

There are not as many species of Tangyanikan cichlids (an estimated 250 species), but the species are more distinct than Malawi cichlids are. Additionally, almost all Tangyanikan cichlids are found exclusively in Lake Tangyanika. Most of these cichlids stay near the floor of the lake, and it is here that you will find the popular shell dweller cichlids that make their homes in empty snail shells. In Lake Tangyanika, you'll find species such as *Tropheus, Lamprologus, Neolamprologus,* and *Julidochromis.* It's also home to perhaps the most popular large African cichlid, the frontosa.

Lake Victoria

Technically speaking, Lake Victoria is not truly a rift lake. The African rift splits into two parts, with each having its own rims and valleys. In between the two is a relatively shallow depression, and it is here that Lake Victoria formed. This has allowed it to have an enormous amount of surface area (second only to Lake Superior) while having significantly less depth than Lakes Tangyanika and Malawi. However, it is close enough both geographically and chemically to be lumped together.

Lake Victoria used to have a huge variety of cichlids, second only to Lake Malawi. Unfortunately, much of this biodiversity has been lost in the past century as the result of human actions. In the 20th century, several species of tilapia and, most notably, nile perch were introduced to Lake Victoria in order to establish a major food and sport fishery. These species have proven to be highly invasive, destroying the natural food chains and pushing many species to extinction. Additionally, pollution from surrounding farming areas as well as cities in Kenya, Uganda, and Tanzania has had significant negative impact.

The introduction of water hyacinth to Lake Victoria has had mixed effects. The increasing nitrogen and phosphorus levels caused by pollution have fed an explosive growth of water hyacinth which in turn has created large areas devoid of any dissolved oxygen and inhospitable to animal life. On the other hand, it has also created additional shelter areas for the smaller cichlids, allowing some of their populations to rebound to a certain extent.

Within the hobby, there is a strong push to conserve Victorian cichlids through initiatives such as the CARES program. Species such as Astatotilapia latifasciata are presumed extinct in the wild but are still commonly available in the hobby. There are also a number of Haplochromis, (as well as species that were formerly classified as Haplochromis but that have since been moved to other genera), Pundamilia, Xystichromis, and other cichlids available that are native to Lake Victoria.

Brackish Fish

Brackish water is found in those areas where freshwater meets saltwater and creates an area that is not really either. It's generally defined as water with a salt concentration ranging between 0.5 and 30 parts per thousand.

Aside from ensuring the salt concentration remains stable, keeping a brackish aquarium is not significantly different than keeping a freshwater one. You can largely use the same equipment in a brackish aquarium that you would use in a freshwater one. All of the same considerations when it comes to ensuring adequate filtration and stable water parameters exist in brackish tanks as they do in freshwater aquariums.

One major consideration when working with salt is that it remains in the aquarium when the water evaporates. This can result in fluctuating salinities. Topping evaporation off with salty water or not compensating for evaporated water when performing water changes will gradually raise the salinity of your tank over time. Make sure you regularly measure your salinity so that you can adjust it as needed.

Something to think about with many brackish fish, though, is that they tend to live in brackish waters only at certain stages of their lives. A number of species will move inland to fresh water in order to spawn and the offspring will gradually move back to saltier waters as they grow. Some brackish fish will eventually even need to be moved to full marine conditions once they get old enough. Many of the brackish fish you see available, such as *Monodactylus spp., Scatophagus spp.,* and archer fish will be offered from freshwater setups but should be transitioned to brackish over time. When you bring home a brackish fish, make sure to start it out in water that matches what it's been living in and gradually adjust the salinity over time.

In addition to monos, scats, and archers, there is a variety of fish that are offered (often as freshwater fish) that do best in brackish setups. Many freshwater eels and puffers are brackish, as are freshwater gobies. Datnoides also should be kept in a brackish aquarium. Even the humble molly is native to brackish environments, though they can be easily kept in fully freshwater aquariums.

Marine Fish

Marine fish come from fully saltwater environments. Generally, this is the ocean, but there are some species native to saltwater seas around the globe. Most marine fish come from reefs and other environments where there is a lot of structure and hiding areas. Some of these will claim specific territories on the reef and will more or less stay within a fairly small range. Others will cruise along the entire reef and require a large amount of swimming space. Most of the marine fish that live in the open areas of the ocean require so much open swimming space that they don't make for good aquarium fish and aren't kept, but there are a few that are attempted.

There's an enormous variety of marine life, ranging from fish to shrimp to crabs to corals and beyond. Marine aquariums are generally set up in one of two different ways: fish only with live rock (commonly called fowlr tanks), and full reef aquariums. Fowlr aquariums may not actually be fish only, as you may also keep certain invertebrates such as shrimp and crabs in there. However, a lot of the fish that are kept in fowlr tanks are quite aggressive and may eat those invertebrates. Reef aquariums incorporate live corals, sponges, anemones, and other reef life into the aquarium and are kept with fish chosen not to eat those animals.

Tropical vs. Cool Water

Most of the fish that we keep in our aquariums come from tropical environments. These areas stay fairly warm all year round, so the fish have evolved to live in those warmer waters. Because fish rely on their environment to regulate their body temperature, warmer waters have several important effects. All of the metabolic processes happen faster. Tropical fish are going to consume more oxygen (which could be potentially problematic because warm water can hold less dissolved oxygen), they're going to eat more, and they're going to produce more waste.

Most people will need to provide a heater for their tropical fish. Some people will have a dedicated fish room they keep warm enough to keep the water temperature up, but that is not a common method. The water in a tropical aquarium should be at least in the mid 70's, but many fish prefer, or even need, water that is even warmer. Discus, for example, should be kept in the low to mid 80's. Realistically, it's probably easiest to learn what fish prefer cooler water and then assume that every other aquarium fish you see is going to be tropical.

Most houses are kept relatively cool, so cold water aquariums can generally be left at room temperature. If you live in a particularly hot area, or like your room to be fairly warm, you may want to think about adding a chiller to cool down the water. By far, the most common coldwater fish are goldfish. Unless your water is at risk of freezing, you don't need to worry about heating their water at all. White Cloud Mountain Minnows, likewise, come from fairly cold environments. Many of the fish that are native to the US also fare well in cool waters, though they are fairly rare in the hobby.

Additionally, there are a variety of species such as gold and rosy barbs, bloodfin and Buenos Aires tetras, and many hillstream species that, while not true coldwater fish, can tolerate temperatures that drop into the mid to upper 60's and that may not need a heater depending on your environment.

Swimming Zones

When you've decided a direction you want to go with your aquarium and are looking at the more detailed specifics of stocking your aquarium, something that is easy to overlook, but can make a huge difference, is where in the aquarium your each fish prefers to stay. Choosing fish that inhabit different swimming zones can help you avoid some problems with aggression as well as add interest to all parts of your tank.

You can think of four primary zones in your aquarium: the middle, the bottom, the top, and the surfaces. There are fish you can find who prefer each of these zones. Unfortunately, most of our tanks are nowhere near as deep as the rivers and lakes that most fish come from, so you're probably not going to get quite as strong of a differentiation in swimming zones in your aquarium as in the wild, but you should still see this behavior exhibit itself.

Middle

Most of our aquarium fish are going to stay more or less in the middle parts of the aquarium. Part of this is because of how relatively shallow our tanks are. If a fish stays within two feet of the bottom of a lake in an area that is 20 feet deep, that fish would probably be considered a bottom dweller. But in a tank that is only 18 to 24 inches high, that fish is going to swim everywhere.

Most tetras, barbs, livebearers, freshwater sharks, a lot of cichlids, goldfish, and many other species we keep will either stay more or less in the middle or across all levels of the aquarium.

Bottom

As mentioned above, most of the space within our aquariums are going to be what is more or less considered the bottom of a natural habitat. However, there are species that are true bottom dwellers, staying on or in the substrate. Some bottom dwellers are fish that are scavengers, searching the nooks and crannies for food that has been overlooked by other fish. Some are species that use the bottom as a place to hide, often digging into the substrate. Finding fish that prefer to stay near the bottom of the aquarium can bring life to an area that is normally just static and dull.

One of the most popular groups of fish that stays primarily on the bottom of the aquarium are the various species of cory catfish. While they will occasionally swim to other areas, most of their time will be spent swimming around the bottom of your tank. Certain loaches, such as yo yo and kuhlii loaches, also prefer to spend their time on (or buried in) the substrate. The shell dwellers will mostly stay in or around the snail shells provided on the bottom of the aquarium. If you have a large enough aquarium, stingrays are another option.

There are certain fish that, while they may not stay on the substrate, will spend a lot of their time closer to the bottom of the tank. Geophagus cichlids are often searching for food they can dig out of the substrate, which keeps them in the lower reaches of your tank for a lot of the time. Apistogramma like to establish their territories in caves near the bottom of the tank. While they won't stay only there, it's not uncommon to see them hanging out in or around the entrance to their cave.

Top

True top swimmers are the most unusual and difficult to find for our aquarium. They're also easy to overlook. Often, the tops of our tanks are below eye level, so it's easy for top swimmers to be "hidden" by our hoods, lights, and even the aquarium rim. They can also be somewhat risky to keep, as many of the fish that stay immediately below the surface of the water have evolved jumping out of the water as a defensive mechanism, meaning they often run a high risk of jumping out of the tank.

The most common top swimming fish are going to be silver and marbled hatchetfish. These spend almost all of their time right below the surface of the water. If you're looking for some oddball fish, halfbeaks and African butterflyfish tend to stay near the surface of the aquarium. In a larger tank, archers and arowana have a tendency to stay near the top due to their instincts for hunting insects in the bushes above their rivers. Certain fish that aren't true top swimmers, such as many of the rainbows, nevertheless have a tendency to be somewhere in the top half of the tank and rarely go down to the bottom.

Surfaces

This category of fish is a little different from the others in that the surfaces in your aquarium are not necessarily consistent areas and will be markedly different from tank to tank. Certain fish will either cling or stay close to the various surfaces within out tank. These could be the actual tank wall, driftwood, rocks, equipment, and any other decorations we may have in our aquarium. There are a few reasons fish evolved to stay in these areas. Many of them feed on algae or other organisms that grow on the surfaces of underwater items. Some fish come from areas with strong currents and cling to surfaces because it uses less energy than swimming against the flow of water. Others do it because it offers protection and hiding from other fish.

All of the plecostomus species will stay attached to driftwood, the aquarium sides, or other decorations in the aquarium, trying to scrape algae and other edible organisms off of those surfaces. Snails, likewise, will always be on some surface in your aquarium as a result of not really being able to swim. Upside down catfish often hide, staying close to the undersides of decorations and plant leaves in your aquarium. Hillstream and butterfly loaches are some of the fish that come from strong currents and that will cling to surfaces in order to stay in one place.

Personality

All animals have some sort of "personality." Fish are no different. Sometimes, the behaviors of fish are fairly consistent across all members of a given species, and other times individuals can be remarkably different from each other. Think about whether or not the fish are likely to get along with each other (there's never any guarantee of this), including both how they'll interact with different members of their own species as well as with other fish.

Inter-Species Aggression

The most basic framework to look at how fish might interact is to create stereotypes for the entire species. For simplicity sake, it's common to break species up into groups, classifying them as peaceful (or community), semi-aggressive, or aggressive. Fish like most tetras, most livebearers, small catfish (such as cories and upside down cats), dwarf gourami, and danios tend to be peaceful. Most barbs, larger gourami, freshwater sharks, angelfish, and smaller cichlids tend to be classified as semi-aggressive. Mbuna, large New World cichlids (oscars, green terrors, jack dempseys, etc), and other large, predatory fish are often fairly to very aggressive.

This can be a useful starting point, but there are so many exceptions and caveats that it can lead to problems. Two different aggressive fish may get along with each other, or they may fight to the death. People have had oscars that won't bother fish small enough to easily eat, while others have had oscars so aggressive that they demand a tank to themselves. Angelfish may be fine with certain semi aggressive tankmates but have their fins get nipped by a fish that is normally considered peaceful. Tiger barbs may be quite feisty when kept in small groups but not bother anything when kept in a large group.

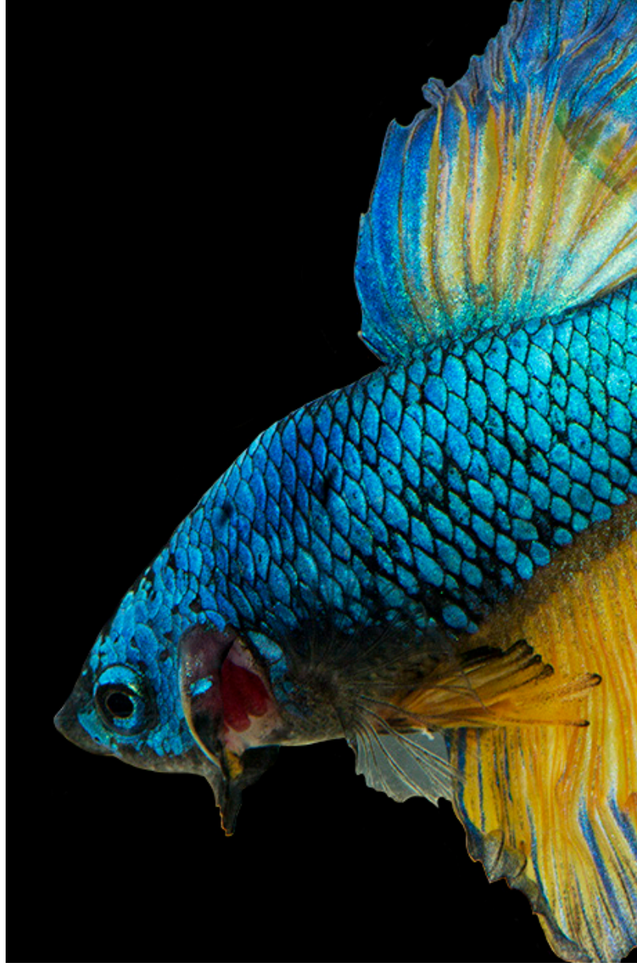
In the wild, most fish are opportunistic feeders and will eat anything small enough to swallow. There are many species, such as most catfish species, that will readily make a snack out of small enough tankmates but not have any problem when kept with larger fish. If you are going to keep fish that have a significant size difference, you need to be very careful about the fish you choose and recognize that there's always a chance the smaller fish will become a meal.

Conspecific Behaviors

When you're talking about multiple fish of the same species, the individuals are said to be conspecifics. While you certainly need to consider how aggressive a fish is likely to be towards the other fish you keep with it, an aspect of personality that is easy for beginner aquarists to overlook is how the fish interacts with others of its own species.

Schooling (Shoaling) Fish

Just the term "school of fish" can evoke strong imagery. In reality, most fish in our aquariums are going to shoal rather than school. What's the difference? Both terms refer to groups of the same fish swimming together, but schooling behavior is much tighter and more coordinated than shoaling. A school of fish acts almost as one unit, with all of the fish closely grouped and swimming (and turning) in the same directions. Shoals of fish are a looser grouping that stays together but the individuals are more likely to be doing their own thing. Even many



of the fish that school together in the wild tend to shoal within the confines of our aquariums. Unless you have a very large tank, it's unlikely that you'll have true schooling behavior.

Schooling and shoaling are both done for the same reason – protection. By staying in a group, each individual fish is less likely to become a target for predators. Large numbers of fish closely bunched together can also confuse predators who may have a hard time deciding where to attack. For fish that evolved to school or shoal, being kept individually or in small groups can be highly stressful. Certain problems can be solved by adding more of a certain fish to your aquarium.

If you can achieve it, getting a school of fish in an aquarium is an unparalleled experience. Many large aquarium keepers choose to keep large cichlids that can't be kept in smaller tanks, but don't rule out putting a lot of a small species into that space instead. Tetras, barbs, silver dollars, danios, and rainbowfish all do better when kept with more of their kind.

Miscellaneous Groups
Some fish seemingly don't care how many of their species are kept together. They're flexible enough to be able to be kept individually, in small groups, or as part of a large group. Other fish prefer to be in a small group. Having an idea of how to put these particular fish together can definitely help create a more successful tank.

Many livebearers, for example, can be kept in almost any size group you want to keep them in. Whether you have two or twenty, it doesn't really matter. A number of cichlids, such as Apistogramma, do best in "harems" where you keep one male with several females. A number of species, such as many African cichlids, can either be kept individually or as part of a large group. For these species, small groups will lead to the weakest fish being picked on relentlessly while larger groups help to spread the aggression around to the point that no individual receives too much.

Loners
Certain fish are highly territorial towards conspecifics. These fish can fall anywhere on the range of aggression towards other species, but when you get multiple ones together they are going to have problems. Perhaps the most obvious example of a loner fish is the male betta. The males will fight to the death with each other and harass females until the female eventually dies. However, male bettas can often be kept with different peaceful fish without problem. (Female bettas, on the other hand, can be kept either individually or as part of a larger group.)

Both redtail and rainbow sharks are also loners when it comes to conspecifics. They can easily be kept with other species (generally semi-aggressive ones), but do not tolerate others of their own kind in their aquarium. They are also similar enough that they won't tolerate each other. A number of large cichlids, such as red devils, are so aggressive towards any tank mate that they don't handle being kept together well unless you can get them to form a breeding pair.

Size
Finally, you need to think about what size tank you are able and willing to set up. If you're starting with an aquarium you already own, base your stocking on that tank. If you are planning on setting up an aquarium around a particular fish that you want to keep, try to make sure to get a large enough aquarium.

One common mistake that aquarists (both new and experienced) often make is choosing stocking based on the current size of the fish they want to keep. With the exception of species that stay very small, most of the fish that you see available in stores are going to be quite young with a lot of growing left to do. While you can certainly move a fish from a small tank to a larger one as it grows, there are a few problems with this plan. The first is that every time you catch and move a fish you are creating stress, potentially increasing the chance of that fish contracting an illness. Second, in the long run this will become more expensive (unless you already have tanks lying around empty) because you're going to have to buy multiple complete setups. Third, it is unfortunately common for aquarists to start out with this plan and then have situations arise that prevents or postpones the tank upgrade.

Nano Tanks - Less than 10 gallons
Nano tanks have been hugely popular for a while and it appears unlikely that they are going anywhere any time soon. Many new fish keepers are attracted to them because they think that their small size will translate to easier experience with less overall maintenance. In reality, that's not the case. The small amount of water they hold requires a lot of precision to keep stable and prevent the buildup of wastes.

It can be very hard to figure out good stocking for a nano tank. You need very small animals that don't require much space. Unfortunately, a lot of species (such as small tetras and danios) that seem like they should work actually won't because you need to keep more than the tank can support. But there are some decent options for a nano tank.

Small invertebrates such as shrimp and small snails are perfect additions to a nano tank. Red cherry and crystal red shrimp (as well as many different color variants of these species) are perhaps most popular, though amano shrimp are prized for their algae eating abilities. There are several snail options, but perhaps best are the freshwater nerites. Despite living in freshwater, they reproduce in marine environments, meaning that you never have to worry about unwanted population growth with them.

Otocinclus are another great option for nano tanks, and can serve as an effective algae eater that won't damage plants. Pygmy cories such as *Corydoras habrosus, Corydoras hastatus,* and *Corydoras pygmaeus* stay small enough that you can keep a group of them in a nano tank. There are also several tiny rasbora species such as dwarf emerald (*Microrasbora erythromicron*) and chili rasboras (*Boraras spp.*) that are small enough to work in a nano tank. Single bettas are also a common choice for nano aquariums.

EXAMPLE STOCKING LIST FOR AQUARIUM SIZES

Nano (app. 8 gals)	Community (29 gals)	Semi-Aggressive (29 gals)	Semi-Aggressive (75 gals)
6 Ember Tetras	**1 Pair Pear Gourami**	**1 Pair Keyhole Cichlids**	**1 Pair Electric Blue Acara**
3 Hasbrosus Cory Catfish	**6 Harlequin Rasboras**	**6 Gold Zebra danios**	**1 Satanoperca juruapri**
6 Bee Shrimp or Cherry Shrimp	**9 Hatchet Fish**	**6 Tiger barbs of any color variety**	**6 Denisoni barbs or 6 Melanotaenia Rainbow fish**
2 Otocinclus	**6 Corydoras**	**6 Neon Rosey Barbs** 4 Females 2 Males	**9 Giant Danios**
	1 Bristlenose Plecostomus	**1 L333 Chocolate Zebra Plecostomus**	**9 Odessa Barbs**
	1 pair German Blue Rams	**3 Upsidedown Catfish**	**1 L200 Green Phantom Pleco**
		1 Dario Loach	**1 Bristlenose Plecostomus**
		Stocked a little heavy to keep aggression down	**3 Brochus splendens**
			Stocked a little heavy to keep aggression down

African Cichlid Tank Malawi (75 gals)	African Cichlid Tank Tanganyika (75 gals)	African Cichlid Tank - Victoria (75 gals, Best in Harems)	New World Cichlid Tank (150 gals)
9 Aulonocara- 3 Males and 6 Females of any variety note they will interbreed and make sure to be responsible with the hybrid fry	**12 Odessa Barbs or 9 Giant Danios** as Dither fish (optional)	**Pick one species and stock 18-20 of them for the best color and compatibility**	**1 Pair Firemouth Cichlids**
1 Male Protomelas Red Empress	**1 Pair Altolamprologus compressiceps any species**	**6 Synodontis Multipunctatus**	**1 Pair Salvini**
6 Labidochromis Hongi Red Top	**6 Neolamprologus brichardi sunflower**	**1 Marble Sailfin Plecostomus**	**1 pair Jewel Cichlids (West African)**
3 Chinese Algae Eaters only add if juvenile cichlids, or allowed to gain significant size before adding sub adult cichlids	**1 Neolamprologus tretocephalus**		**3 Clown Loaches**
3 Synodontis multipunctatus	**6 Julidochromis transcriptus**		**18 Giant Danios as Dither Fish**
	1 pair Eretmodus cyanostictus		**1 Hercthys bocourti**
Heavily stocked to keep aggression down	**6 Synodontis petricola**		**3 Synodontis decorus L091 Leporacanthicus triactis tri beacon pleco**

Small Tanks - 10 to 29 gallons
Tanks between about 10 and 29 gallons are fairly popular and can make good choices for new fish keepers. The extra water over a nano tank helps to stabilize the aquarium and more space gives you more flexibility with stocking. There are definitely still limitations, but they are nevertheless easier to appropriately stock than a nano.

With a small tank, you can keep most livebearers, dwarf gourami, blue eyed rainbows (*Pseudomugil spp.*), and zebra danios (among other options). The larger small tanks can keep a decent sized shoal of most tetras (some of the larger species you may want to go for a larger aquarium) as well as some of the smaller cichlids such as the African shell dwellers. Smaller pleco species such as the bristlenose pleco are also a good option for small tanks.

Medium Tanks – 29 to 55 gallons
Medium tanks are perhaps the best option for new aquarists, and they make great choices for all aquarium hobbyists. The 55 gallon aquarium has long been the most popular aquarium size for many years. Medium sized aquariums seem to strike the best balance between stability and stocking options while still being fairly easy to maintain and handle.

With a medium sized aquarium, you can keep a good sized group of larger tetras, tiger barbs, rainbowfish, and giant danios. You can also keep some of the small to medium sized cichlids such as apistos, rams, firemouth cichlids, acaras, and many African cichlids. Synodontis catfish and medium sized plecos (such as rhino plecos) are also options.

Large Tanks - 55 to 125 gallons

If a 55 gallon aquarium is the most popular kid in class, the 75 gallon is its more capable, yet underrated, friend. The physical difference between a 55 and a 75 is only an extra six inches from front to back, but those six inches can make a huge difference. Some of the most popular cichlids, such as oscars, can reach lengths around 14 inches long. The 18 inches of space from front to back makes turning around much easier than the 12 inches in a 55 gallon. Moving up to large tanks dramatically increases your fish options, and you are able to have larger groups of fish in the same tank.

That being said, going larger than 55 gallons does start to introduce some new challenges. As tanks get bigger, they get heavier and more difficult to move. An average person can fairly easily move a 30 gallon tank, and a 55 can be handled by one strong or two average people. As you move up to 75, 90, and especially 125 gallon aquariums, you start to really need a couple strong people (or even an extra pair of hands or two). If you don't have convenient access to a drain and a water source, water changes start to become more labor intensive, but the extra capabilities of large aquariums make them well worth it.

Because large fish need large aquariums, many of the people who buy large tanks are doing so in order to keep those fish. However, don't discount the idea of keeping large groups of small fish in a large tank. A 125 gallon aquarium nicely aquascaped with driftwood and plants that houses schools of dozens of cardinal tetras, cories, and perhaps a handful of larger fish can be an incredible sight.

In addition to housing larger groups of small shoaling fish, large aquariums allow you to keep larger groups of discus, angelfish, and African cichlids. You can also look at larger cichlids such as *Amphilophus, frontosas, Tilapia buttikoferi,* jaguar cichlids, and certain *Cichla* species.

Monster Fish - 125+ gallons

There are some great fish that grow to massive sizes. These fish, commonly called monster fish in the hobby, pose some serious challenges for fish keepers. That doesn't mean that they are impossible to keep or that they are bad choices for those who can, but monster fish require you to make some significant investments in time, space, and money.

Most fish stores only stock tanks up to around 55 or 75 gallons. Occasionally you will see a 125 in a store, but tanks larger than that are exceedingly rare to find. Some higher end specialty local fish stores may have larger tanks, but most of the time you're going to need to custom order larger aquariums. Massive tanks are expensive, hard to move, and extremely heavy once you fill them up. When you get into this size of tank, you need to ensure your flooring is strong enough to support that weight.

A lot of people who keep these fish build their own tanks or even indoor ponds to house them in. That can save a fair amount of money, but requires a lot of skill and experience to do well. Having somebody else custom build one for you is going to be a significant investment. You also have to think about ensuring your filtration and heating system are strong enough and that you're budgeting for the power they'll consume. Large tanks and ponds that are not covered can introduce a huge amount of humidity into your room, increasing the risk for mold related problems. Finally, if you're unlucky enough to have a crack or some other catastrophic failure, you risk having significant damages to your home. If you want to keep monster fish, make sure that you are willing to invest the resources and efforts into setting up an appropriate environment to keep that fish for its entire life. It can be very difficult to find a new home for a four foot long fish.

If you're wanting to keep monster fish, there are some amazing options out there. Silver arowana are incredibly graceful giants that can grow to lengths of four feet or more. There are several catfish species, such as redtail and tiger shovelnose cats, that are quite popular yet outgrow most aquariums. The smaller gar species, such as Florida and spotted gar, can grow to three feet, while the giant alligator gar can reach lengths of more than eight feet (arguably not suitable for any home aquarist). Some of the larger *Cichla* species are also good options for aquarists wanting monster fish.

Common Aquarium Species Quick Reference

There are far too many fish available in the hobby to fit information on all of them into this book. The chart on the next few pages offers an overview on some of the most commonly seen aquarium fish.

BROAD FISH GROUP	SPECIFIC FISH GROUP	NATIVE HABITAT	WATER CHEMISTRY	SWIMMING ZONE	INTER-SPECIES AGGRESSION	CONSPECIFIC AGGRESSION	MINIMUM TANK SIZE
African Cichlid	Yellow Lab (Electric Yellow)	Lake Malawi	Alkaline	Mid to Bottom	Cohabitates well with less aggressive Mbuna, Haplochromis and Aulonocara	Aggressive towards others males in the Labidochromis Genus	30 Gallons
African Cichlid	Cobalt Blue Zebra	Lake Malawi	Alkaline	Mid to Bottom	The more the merrier to deter aggression, can be kept with boisterous Haplochromis and Protomelas	Aggressive towards others males in the Pseudotropheus Genus	30 Gallons
African Cichlid	Jacobfreibergi Peacock Cichlid	Lake Malawi	Alkaline	Middle	Cohabitates well with less aggressive Mbuna, Haplochromis and Aulonocara	Aggressive towards others males in the Aulonocara Genus	55 Gallons
African Cichlid	Assorted Peacocks	Lake Malawi	Alkaline	Mid to Bottom	Best kept in Large groups 18 or more of the same species	Aggressive towards others males in the Aulonocara Genus	55 Gallons
African Cichlid	Frontosa	Lake Tanganyika	Alkaline	Mid to Bottom	Become aggressive outside of a colony. Can be kep with other Tanganyikan cichlids over 6 inches as well as Aulonocara, Mild haps and Protomelas	Best kept in large Groups of the same Genus	75 gallons for one, 125+ gallons for a group
African Cichlid	Frontosa	Lake Tanganyika	Alkaline	Mid to Bottom	Become aggressive outside of a colony. Can be kep with other Tanganyikan cichlids over 6 inches as well as Aulonocara, Mild haps and Protomelas	Best kept in large Groups of the same Genus	75 gallons for one, 125+ gallons for a group
African Cichlid	Brichardi	Lake Tanganyika	Alkaline	Mid to Bottom	with Sufficient caves, can live with most other Similar size Tanganyikan Cichlids and Mild Malawi Cichlids	Bond in Pairs and become aggressive towards other Neolamprologus	20 gallons
African Cichlid	Tropheus Moorii	Lake Tanganyika	Alkaline	All levels	Should be kept in a large single species colony with no other fish	Best kept in Large groups 18 or more of the same species	55 gallons for a group
Barb	Tiger Bard	Indonesia	Neutral	Middle	Semi-Aggressive. Tiger barbs have a reputation for being nippy, but this can be minimized when kept in groups. Avoid keeping with slow moving species that have long fins.	Highly social. The more that can be kept, the better. Inter-species aggression is lessened when they are given a large shoal.	30 gallons
Barb	Cherry Bard	Sri Lanka	Neutral	Middle	Peaceful, but may be somewhat nippy when kept individually or in very small groups	Very social. Keep in as large of a group as possible.	10 gallons
Barb	Tinfoil Bard	Southeast Asia, Mekong and Chao Phraya Basins	Neutral	Middle	Semi-Aggressive, but they grow large enough to be a threat to small tankmates and to be able to be kept with some moderately aggressive tankmates.	Social, prefers to be kept in shoals.	75 gallons, but larger is better due to their large size (14 inches) and schooling behavior.
Barb	Denisonii Barb/ Roseline Shark	India	Neutral to slightly alkaline	Middle	Peaceful	Schooling species, best kept in groups.	55 gallons
Betta	Betta	Mekong Basin	Neutral	Middle to top	Peaceful, but may be somewhat nippy, particularly towards long finned tankmates. Easy target for other nippy species	Males will fight to the death and harass females. Females are generally best kept either individually or as a part of a larger group.	5 gallons is ideal for water stability, but can keep in tanks as small as 1 gallon with proper maintenance
Brackish	Archer	Indo-Pacific	Brackish	Top	Semi-Aggressive. Can be kept with other brackish fish around the same size	Do well in small groups of 3 to 5, provided individuals are similar in size	55 gallons
Catfish	Redtail Catfish	Amazon, Orinoco, and Essequibo River Basins	Neutral	Bottom	Will eat any tankmates small enough to swallow.	Similar sized individuals should be able to be kept together	75 gallons when young, custom aquarium or pond when large (can grow to around 5 feet)
Catfish	Striped Raphael Catfish	French Guiana and Suriname	Neutral	Bottom	Generally peaceful, but may eat small tankmates	Can be kept individually or in any size group	30 gallons
Catfish	Polka Dot Pictus	Amazon and Orinoco River Basins	Soft to neutral	Bottom	Generally peaceful, but may eat very small tankmates	Can be kept individually or in any size group	30 gallons
Catfish	Synodontis eupterus	African rivers	Neutral to alkaline	Bottom to middle, may also stay near surfaces	Generally peaceful, but may eat tankmates small enough to swallow.	Generally peaceful with each other.	30 gallons
Cory Cat	Panda Cory	Peru and Ecuador	Soft to neutral	Bottom	Peaceful	Prefers to be kept in large groups	10 gallons
Cory Cat	Paleatus Cory	Brazil, Uruguay	Soft to neutral	Bottom	Peaceful	Prefers to be kept in large groups	5 gallons
Danio	Zebra Danio	India	Neutral	Top	Peaceful, can be nippy in small groups	Best in groups of three or more	10 gallons

BROAD FISH GROUP	SPECIFIC FISH GROUP	NATIVE HABITAT	WATER CHEMISTRY	SWIMMING ZONE	INTER-SPECIES AGGRESSION	CONSPECIFIC AGGRESSION	MINIMUM TANK SIZE
Danio	Giant Danio	Sri Lanka, Nepal, India	Neutral	Top	Peaceful, can be nippy in small groups	Best in groups of three or more	30 gallons
Freshwater "Shark"	Bala Shark	Southeast Asia (Malay Peninsula)	Neutral	Top	Peaceful, can be nippy in small groups	Best in groups of three or more	30 gallons
Freshwater "Shark"	Iridescent Shark	Southeast Asia, Mekong and Chao Phraya Basins	Neutral to acidic	Middle	Peaceful	Can be Singular or in groups	29 as juveniles, Custom Aquarium or pond as Adults
Freshwater "Shark"	Rainbow Shark	Southeast Asia	Neutral to acidic	Bottom	Semi Aggressive, Will chase tank mates-Best kept with Barbs and Semi Aggressive Cichlids	Will be very territorial, keep one per tank	30 gallons
Goldfish	Comet	Originally east Asia, now domesticated and significantly different from natural wild species	Neutral to alkaline	All levels	Generally Peaceful	Can be Singular or in groups	30 gallons
Goldfish	Oranda	Originally east Asia, now domesticated and significantly different from natural wild species	Neutral to alkaline	All levels	Generally Peaceful	Can be Singular or in groups	30 gallons
Goldfish	Black Moor	Originally east Asia, now domesticated and significantly different from natural wild species	Neutral to alkaline	All levels	Generally Peaceful	Can be Singular or in groups	30 gallons
Gourami	Dwarf Gourami	Pakistan, India, Bangladesh	Neutral to acidic	Mid to bottom	Peaceful, but may be somewhat nippy, particularly towards long finned tankmates. Easy target for other nippy species	Should be kept singular but mostly community friendly	15 gallons
Gourami	Pink Kissing Gourami	Southeast Asia	Neutral to acidic	Middle	Semi-Aggressive will eat smaller tank mates	Singular or large groups	55 gallons
Gourami	Blue Gourami	Southeast Asia	Neutral to acidic	Middle to top	Semi-Aggressive community fish with other semi-aggressive barbs	Singular or Pairs	20 per fish
Livebearer	Guppy	Northeast South America	Neutral to alkaline	All levels	Peaceful-Can become nippy when pursuing females or sparring with other males	Keep in trios or 2-1 ratio	10 gallons
Livebearer	Molly	US and Mexico (depending on species)	Neutral to alkaline	All levels	Peaceful-Can become nippy when pursuing females or sparring with other males	Keep in trios or 2-1 ratio	10 gallons
Livebearer	Platy	Mexico and Central America	Neutral to alkaline	All levels	Peaceful-Can become nippy when pursuing females or sparring with other males	Keep in trios or 2-1 ratio	10 gallons
Livebearer	Swordtail	Mexico and Central America	Neutral to alkaline	All levels	Peaceful-Can become nippy when pursuing females or sparring with other males	Keep in trios or 2-1 ratio	10 gallons
Livebearer	Variatus	Mexico	Neutral to alkaline	All levels	Peaceful-Can become nippy when pursuing females or sparring with other males	Keep in trios or 2-1 ratio	10 gallons
Loach	Clown Loach	Indonesia, Sumatra, Borneo	Neutral to acidic	Bottom	Peaceful	Best kept in groups of 3 or more	55 gallons
Loach	Kuhlii Loach	Indonesia and Malay Peninsula	Neutral to acidic	Bottom	Peaceful	Best kept in groups of 3 or more	10 gallons
Loach	Yo-Yo Loach	India	Neutral to acidic	Bottom	Semi-Aggressive	Keep singular or in large groups	30 gallons
Miscellaneous	Silver Arowana	Amazon Basin	Neutral to acidic	Top	Predatory but not very aggressive, keep with other large peaceful fish	Keep Singular	180 gallons
Miscellaneous	Red Belly Pacu	Amazon and Orinoco River Basins	Neutral to acidic	All levels	Semi-Aggressive	Can be Singular or in groups	55 gallon as juveniles Custom tank when adult
Miscellaneous	Silver Hatchet	Amazon Basin	Acidic	Top	Peaceful-will jump	Best kept in groups of 6 or more	15 gallons
Miscellaneous	Silver Hatchet	Amazon Basin	Acidic	Top	Peaceful-will jump	Best kept in groups of 6 or more	15 gallons
Plecostomus	Common Pleco	Northeast South America	Neutral to Acidic	Bottom	Peaceful	Can be Singular or in groups	55 gallons
Plecostomus	Bristlenose Pleco	Amazon Basin	Neutral	Bottom	Peaceful	Males can spar when breeding	20 gallons

BROAD FISH GROUP	SPECIFIC FISH GROUP	NATIVE HABITAT	WATER CHEMISTRY	SWIMMING ZONE	INTER-SPECIES AGGRESSION	CONSPECIFIC AGGRESSION	MINIMUM TANK SIZE
Plecostomus	Clown Pleco	Venezuela	Neutral to acidic	Bottom	Peaceful	Can be Singular or in group	10 gallons
Rainbowfish	Boesemani Rainbow	Indonesia	Neutral to slightly alkaline	Middle	Semi-Aggressive/Community can be kept with most community fish but do get nippy and boisterous	Best kept in trios	30 gallons
Rainbowfish	Threadfin Rainbow	Indonesia, Australia, Papua New Guinea	Neutral	Middle	Community-Slightly nippy	Males can be a nippy	15 gallons
Rasbora	Harlequin Rasbora	Malaysia, Singapore, Sumatra, Thailand	Neutral to acidic	Middle	Community	Best kept in groups of 3 or more	10 gallons
South American Cichlid	Oscar	Amazon Basin	Neutral to acidic	All levels	Aggressive	Singular or in a Pair	75 gallons
South American Cichlid	Jack Dempsey	Mexico and Honduras	Neutral to acidic	Middle to Bottom	Aggressive	Singular or in a Pair	55 gallons
South American Cichlid	Discus	Amazon Basin	Acidic	Middle to Bottom	Peaceful-will eat small fish	Best Kept in groups of 6 or more unless breeding pair	55 gallons
South American Cichlid	Angelfish	Amazon Basin	Neutral to acidic	Middle	Mostly Peaceful-Can be territorial when breeding	Best kept in pairs or singular	30 gallons
South American Cichlid	Red Devil	Nicaragua	Neutral to acidic	All levels	Aggressive	Will kill any tank mates very rare occasion a female can be housed if adequate hiding is offered	75 gallons
South American Cichlid	Apistogramma cacatuoides	Amazon Basin	Neutral to acidic	Mid to bottom	Community-can be slightly territorial	Best kept in pairs	30 gallons
South American Cichlid	Geophagus	South America	Neutral to acidic	Mid to bottom	Depends on the species Range from semi aggressive to aggressive	Keep Singular or in large groups	30-75 gallons depending on species
South American Cichlid	Convict	Central America	Neutral to acidic	Mid to bottom	Very aggressive in a pair	Keep singular with other aggressive cichlids or in a pair with other cichlids in large tank	30 gallons
Tetra	Neon Tetra	Colombia, Peru, Brazil	Neutral to acidic	Middle	Community	Keep in groups of 3 or more	10 gallons
Tetra	Cardinal Tetra	Rio Negro and Rio Orinoco	Neutral to acidic	Middle	Community	Keep in groups of 3 or more	10 gallons
Tetra	Bloodfin Tetra	Brazil, Paraguay, Argentina	Neutral to acidic	Middle	Community	Keep in groups of 3 or more	10 gallons
Tetra	Black Skirt Tetra	Brazil, Paraguay, Argentina	Neutral to acidic	Middle	Community	Keep in groups of 3 or more	15 gallons
Tetra	Red and Blue Colombian Tetra	Colombia	Neutral to acidic	Middle	Community	Keep in groups of 3 or more	15 gallons

6 PLANNING IT OUT

The best aquariums start with a plan, and the best plans start by asking a lot of questions. What do you want from your finished aquarium? What are you going to put in it? Do you find yourself drawn to the more natural looking aquariums, or do you have a vision of sunken treasure ships and accessories? Do you want something that is dense and chaotic, something clean and orderly, or something sparse and minimalistic? Asking (and answering) questions like this can give you a clear plan of how you want your aquarium to look will help you when standing in the aisle of endless decorations.

Visualize a general theme

When you set up an aquarium, there are several routes you can go. Perhaps you have a fish chosen that you want to keep and you want to set up your aquarium to best meet its needs. Or perhaps you want to set up a biotope aquarium and recreate a specific habitat in the greatest detail possible. You need to identify the goal of why you are setting up this aquarium and ask yourself, what makes **you** happy?

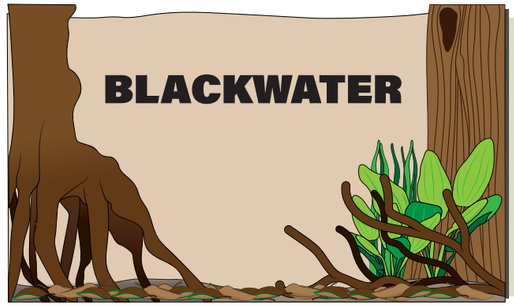
One of the best solutions is to find some pictures that you are inspired by and take them with you to the store. To help guide your decision, there are a few general styles that are common, and learning about them can help you know what you need to do. But keep an open mind when looking around the pet store, take your time, and ask employees who have set up displays for tips. When it comes to décor, there is really no wrong way to aquascape a tank.

Biotopes

Biotopes have become an increasingly popular choice when it comes to planning out an aquarium. If you're inspired by a very natural tank, than this may be a good path to follow.

Biotope aquariums focus on a specific area in the wild and use things you might find there. All of the fish and plants will be species that are native to that

Popular BioTopes



Locale: Rio Negro

Example Fish:
Angelfish, Cardinal Tetras, Rummynose Tetras, Silver Hatchetfish, Cory Catfish

Example Plants:
Cabomba, Narrow Leaf Chain Sword, Brazilian Pennywort

Substrate: Sandy

Other Decorations: Driftwood and Heavy Leaf Litter

Notes:
One of the primary characteristics of the Rio Negro is the tea-colored water that results from tannins released by leaves. Regularly replace the leaves as they fall apart, and think about using peat to supplement and add more tannins to the water.

Locale: Lake Malawi

Example Fish:
Mbuna, Peacocks, Synodontis Catfish

Example Plants: None

Substrate: Sand or Fine Gravel

Other Decorations: Lots of Rockwork

Notes:
The African Rift Lakes feature large amounts of boulders and piles of rocks that form caves and territories for the fish. Choose a substrate that can help buffer the high pH found in the rift lakes.

Locale: Amazon River

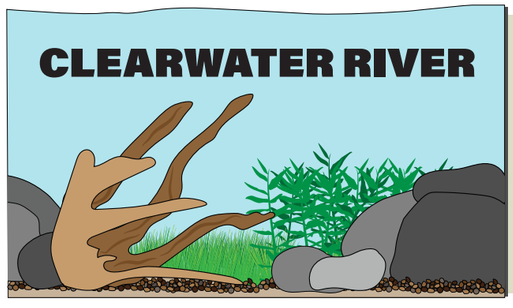
Example Fish:
Geophagus, Oscars, Acaras, South American Tetras, Cory Catfish

Example Plants:
Sword plants, Myriophyllum, Lilaeopsis

Substrate: Sand or Fine Gravel

Other Decorations: Driftwood

Notes:
A Whitewater biotope will include a lot of open swimming space and more flow and oxygenation than other aquarium styles.



Locale: India

Example Fish:
Danios, Rosy Barbs, Dwarf Gourami, Roseline Sharks, Clown Loach

Example Plants:
Rotala, Aponogeton, Eleocharis, Blyxa

Substrate: Sand or Fine Gravel

Other Decorations: Rocks and Driftwood

Notes:
Indian rivers often feature dense plants, so think about using a substrate designed for plants or including some sort of soil under the gravel. Rocks and driftwood should be included to give hiding areas and variety and should accent the plants

area, and the decorations you choose should match what you would find if you were to swim in those waters.

A strict biotope will only use what naturally exists together. But if you're new to aquariums and want more options, you could do a more flexible interpretation. For example, you might choose species from across the Amazon basin instead of only those found in the Rio Xingu.

Benefits of Biotopes

While setting up an authentic biotope may require a fair amount of planning and impose a number of limitations on what you can add to your aquarium, there are a number of benefits to setting one up that traditional aquariums don't offer.

Ensures a certain amount of compatibility

Because all of the fish and plants in your aquarium are native to the same area, they are going to have evolved to take advantage of the same water conditions. You don't have to worry about one of your fish needing a different pH, hardness, or amount of water flow.

Helps reduce illness

The primary cause of disease in an aquarium is a compromised immune system from stress. By providing exactly the conditions that a fish innately wants you can minimize the stress, keeping your fish healthy and thriving.

Can reduce aggression

While there is no guarantee that every fish from a given environment is going to be compatible (there are predator and prey species everywhere, after all), you can have a better chance of finding compatible species when sticking with fish that naturally live together. They have adapted over thousands of years to develop instincts for survival and to fill unique ecological niches.

Creates stability

A well planned biotope emulates nature. Each species has a purpose. The goal is to set up an environment that is sustainable, much like a reef tank. Though performing small water changes and monitoring water chemistry will still be necessary, proper feeding and stocking densities make biotopes relatively easy to maintain.

Biotope Challenges

The trade off to these benefits is that there are specific challenges that come with biotopes.

Potentially significant stocking limitations

By keeping a biotope, you are limiting your aquarium to a very small pool of species (pun intended). You need to do plenty of research so that you know what you're "allowed" to keep while staying within your biotope. Depending on what you choose and the sourcing options in your area, finding those specific species may take extra time and effort. If you are looking for wild fish, many are seasonal and may have very limited collection times.

If you're wanting to keep plants in your biotope, the plants that are native to that environment may not be available at all. They might have never been collected and grown for aquarium hobbyists, or they may even be illegal to import into your country. If it's not possible to get the right plants, you may need to choose a different biotope or be okay breaking your own rules and get similar plants that are native to different areas.

Figuring out how to decorate your tank

In addition to figuring out the species that fit into a biotope, in order to set up a fully realized biotope, you need to try to imitate the way everything appears in nature. Should you use sand, gravel, or pebbles for the substrate? Is the environment rocky or is there driftwood? Is the wood primarily roots sticking up out of the bottom or is it branches hanging down into the river? The only ways to find out are to either physically go there and look (which is unrealistic for many people) or to find underwater pictures of those habitats (which can be difficult to find).

Ensuring compatibility

Ok, so this falls under both benefits and challenges but it's true in both categories, depending on the fish you choose. While many of the fish who live in the same area naturally cohabitate with no problems, you also have times when one fish naturally eats another fish in the wild. Neon tetras, for example, are a common natural food for angelfish. If there is the potential for significant problems between the species you choose, make sure you have plenty of space and appropriate territories for each to claim and hide from each other.

Biotope Considerations

When you decide to create a biotope, you need to think about what pieces need to be put in place in order to realize your vision. Try to research the area to get an idea of what physical objects are in that habitat. Are there trees along ide the river? Long stretches of sandy shores? Turbid water with leaves and sticks? Try to picture what the fish will encounter as they start and end their day. What obstacles would they face as they for-

age, rear fry, and look for suitable mates? In addition to choosing what species you are going to include in your biotope, there are some other things you need to think about to truly recreate a natural habitat.

Hardscape

Look at what is going on in and around the water. Some rivers have tree roots or branches hanging down into the water where fish will congregate. There may be a lot of rocky areas that the fish use as cover and territory. Do these rocks jut out, or are they smooth and strewn about in small piles? When shopping for these items you will have many choices to help create the vision you are going for. Just be careful to keep in mind how any hardscape may affect your water chemistry.

Substrate

In the wild, you will find that there is quite an array of substrates. Luckily for you, there are many options available commercially. Does your biotope feature fine sand that the fish dig through? Does it feature larger pebbles (or even boulders) that the fish swim above? Providing the right substrate can help bring out the natural behaviors in your fish.

Waterflow

The way that water flows through your tank is something that can be easily overlooked. A rapidly flowing mountain stream is going to be very different from a slow moving river which is going to be very different from a relatively stagnant lake which is going to be very different from the chaotic turbulence of a reef. Understanding where your fish come from can help you know what kind of flow you should offer your biotope fish.

If your biotope is a fairly gentle river or lake, you will likely be fine with the flow created by an adequate filter. For an area with more turbulence, you'll probably want to add powerheads to increase the amount of flow in your aquarium. Additionally, the water in highly turbulent mountain streams are highly oxygenated, so you might need to add airstones for them to thrive.

Water "color"

For most of us, we have a picture in our heads of a crystal clear aquarium with a clean gravel bed and decor. However, many natural bodies of water not like this. There are three general "colors" of water that occur in nature. ***Clearwater*** is, as the name implies, relatively clear and is the closest to the stereotypical aquarium.

Whitewater is what you think of when you go rafting. It is extremely turbulent and as a result has a lot of air bubbles present, making it appear white (although it will clear up quickly once the turbulence is removed). There are some aquarium fish that come from whitewater environments, but recreating the very high flow is quite difficult in an aquarium. The easiest approximation would involve powerheads that utilize venturis to push extra air into the water column.

Finally, there are blackwater habitats. ***Blackwater*** is created when leaves, wood, and other plant matter release tannins into the water, staining it a sort of tea color. Fish that are native to these habitats may not adapt to totally clear water very easily or never display their true colors without it.

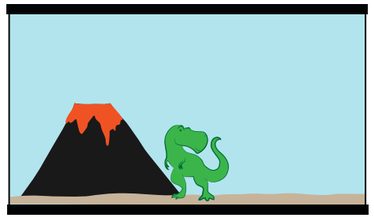
You can create blackwater conditions by adding Mopani or Malaysian driftwood, Indian almond leaves, alder cones, or even extracts available at your local fish store. Activated carbon will remove tannins from the water, so you will need to remove it from your filter if you want to create a blackwater tank (or, alternatively, add it if you want to use driftwood in a clearwater tank and need to get rid of tannins).

Plant Life

Finally, you need to think about the presence (or absence) of plants in your biotope. In addition to what kind of plants should be used, you need to determine how those plants should be added to the overall layout. In the wild, do they grow tightly packed, or are the more scattered and patchy? Creating the most realistic biotope will involve trying to match nature.

The "Unnatural" Aquarium

Most aquariums are going to be a collection of different pieces that the aquarist likes and won't reflect nature. On one end of this spectrum, there may be a superficial similarity but the tank is full of species that would never actually be in the same place or in an aquascape completely different from their natural habitat. On the other end of the spectrum would be the tanks filled with sunken ships, neon volcanos, and tiny castles.

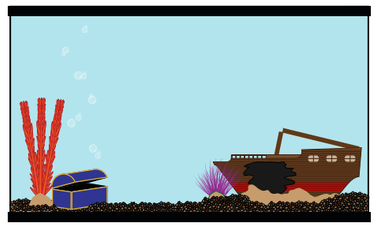


And there is absolutely nothing wrong with a fish tank fully decked out with plastic ornaments if that is how you want it to look. In fact this can be a great way to stay creative and make your aquarium truly your own work of art. In these "unnatural" aquariums, there are no rules on what to add or where to put it. Whatever you want to create, you can.

There is a huge variety of ornaments available, and it's very possible to find yourself a bit overwhelmed standing in front of them at the fish store. If you need some inspiration, look at pictures of other aquariums that you like. Try to create an entire scene. A standalone castle is not very impressive, but creating the surrounding elements that you would see such as boulders, hedges, and mountains in the background can make it come to life.

Emulating Nature With Synthetic Materials

When you create a biotope, you are naturally going to create the features your fish need. The rocky piles and caves you create in an African Rift Lake biotope allows the fish to claim the same sorts of territories they would in the wild. Because an unnatural aquarium may be set up completely unlike where any fish comes from, you don't automatically have this benefit anymore.



However, that doesn't mean that you can't satisfy these same needs in an unnatural aquarium.

That artificial castle or sunken ship is likely hollow with holes in the side. Fish that instinctively seek out caves as territories will use these decorations for that purpose. Fish that like to hide among plants generally won't care if they are live or neon plastic. That plastic volcano likely connects to an air pump to create a fine stream of bubbles that will provide the oxygenation that hillstream and whitewater species need.

When choosing the decorations that you're putting into your tank, spend a little bit of time thinking about what sort of environmental needs your fish have and try to figure out ways to provide them. Offering a variety of size, shape, and types of decorations will give you a better chance of providing the ideal spot for each of your fish.

Planted Aquarium

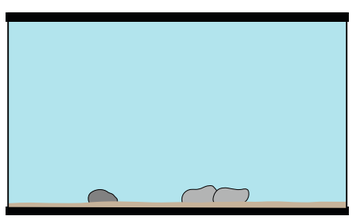
In certain circles within the aquarium hobby, there is a large push towards setting up planted tanks. While there are a lot of different styles of planted tanks, what they all have in common is a significant focus on creating the best conditions possible for the live plants in your aquarium, often with the fish taking a back seat.

Some biotopes which are heavily planted can classify as planted tanks, but there are many other styles as well. Some planted tanks focus on including as many plants as possible. Others try to recreate nature scenes such as imitating the look of a forest, mountain range, or home garden.

There are a number of techniques that are unique to planted aquariums that other aquarium keepers don't really have to worry about. To successfully keep plants, you have to make sure you can balance the amount of light, nutrients, and even carbon dioxide they receive. To create an attractive aquascape, you need to carefully consider the placement of any hardscape (rocks and driftwood) you use and how it interacts visually with the plants you choose to use.

For a more detailed look at planted aquariums, check out Chapter 9 where we discuss these topics more in depth.

The Minimalist Aquarium



Perhaps your tastes run more towards sleek and simple

and farther away from bringing nature into your home. You might think about setting up a minimalistic aquarium that is stripped of all the normal features you find in an aquarium. You may only include a small amount of substrate and one or two structures for the fish, or you may go completely bare, with nothing but the tank, water, and fish.

While this can be a stylistic choice, you can also set up a minimalist aquarium for more utilitarian reasons. Perhaps the most common example would be when keeping fish such as arowana and stingrays that need a lot of open swimming space and can easily hurt themselves on decorations. It can also be done when your primary focus is on breeding certain fish and want to set up tanks that contain nothing more than a sponge filter and a piece of slate or ceramic pot for the fish to adhere their eggs to.

While minimalist tanks can be very successful, they also present some very real challenges.

Certain fish are not going to do well in a minimalist tank. If the fish you're wanting to keep needs a certain amount of cover to feel comfortable, a minimalist tank won't provide it. Those fish will be timid and stressed, leading to a number of problems

Maintaining a minimalist tank requires a bit more effort and attention than many other tanks. A certain amount of your beneficial bacteria will live in the gravel and on the various surfaces in your aquarium. Remove them, and you need to ensure that your filtration is sufficient to make up the difference. A lot of detritus will settle into the gravel of a typical aquarium where it will be hidden from view until it breaks down. Without any sort of substrate, you need to make a special effort to prevent this detritus from building up on the bottom of the aquarium.

Planning Your Layout

Alright, you've decided on a theme to follow. You've purchased your castles, your perfect gravel and boulders and bushes... so now what? It can be a challenge to decide where you want to place all the pieces you've chosen for your layout. If you're copying a picture of a wild habitat for a biotope, that can help you get started. But what about when you're creating something more from scratch? Lucky for us, mankind has been creating art for thousands of years and discovered some guidelines that will help you create your aquatic masterpiece.

The Rule of Thirds

Nature is full of symmetry. It's easy to try to take this into your aquarium. Your instincts may tell you to take your main item of focus and center it in the tank. But when you do this, you will find that you lose depth and it will be more difficult to create dimension.

A very common concept in art and photography, that also helps with planning a more visually pleasing aquarium layout, is the Rule of Thirds. This guideline says that the most interesting focal points are at the intersections of dividing the canvas/photo frame/aquarium into thirds. In other words, if you were to imagine lines dividing the aquarium into three even pieces vertically and horizontally, you should try to put the main features along those lines.

This method is a good starting point because your eye naturally wants to follow a path. If you have a primary focal point at one third line and a smaller, secondary focal point on another, your eye will naturally be drawn first to the most commanding object and then to the supporting items. If the focal point is in the front and center, it creates a sort of dead space where your attention sinks into the one space and doesn't have anywhere else to go.

How you can apply the Rule of Thirds in an aquarium depends on what you are putting into the tank. If you have a large rock or piece of driftwood, put the main part of it on one of the vertical third lines. If you are also using some relatively short plants, think about arraging them to cover the bottom third line.

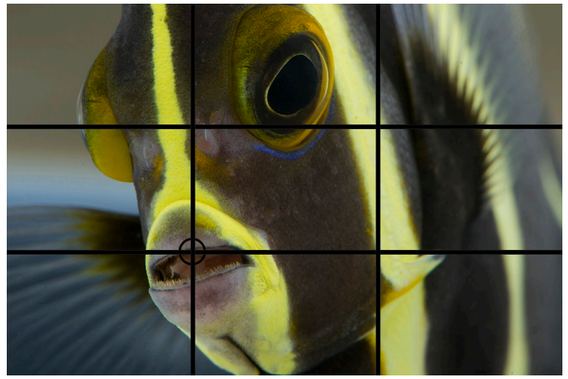
Because aquariums are three dimensional, you can also use the front and back thirds to add an additional sense of depth. Think about having your larger decorations along the back third and your smaller ones in front of them on the front third.

Negative Space

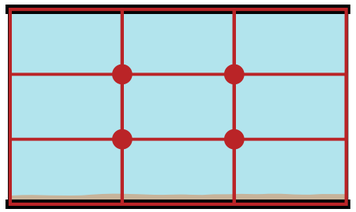
While it's obviously important to figure out the best places to put stuff in your aquarium, it's easy to forget about considering where ***not*** to put stuff. When you're trying to create a sense of depth and flow in your aquascape, the negative (empty) space is just as important as the filled space. If you stuffed all of the gaps with plants and decor, your tank can easily and quickly appear to be two dimensional.

Use the natural negative space provided by your primary decorations to create a point of interest as well as a dynamic place that your fish will swim in and out of. If

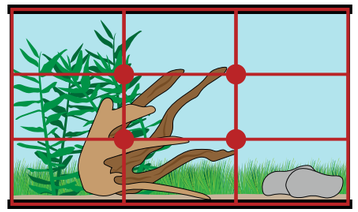
Rule of Thirds in Photography



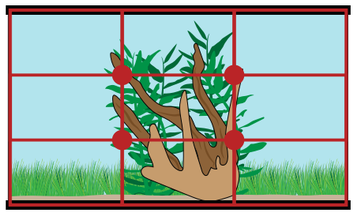
Rule of Thirds in an Aquarium



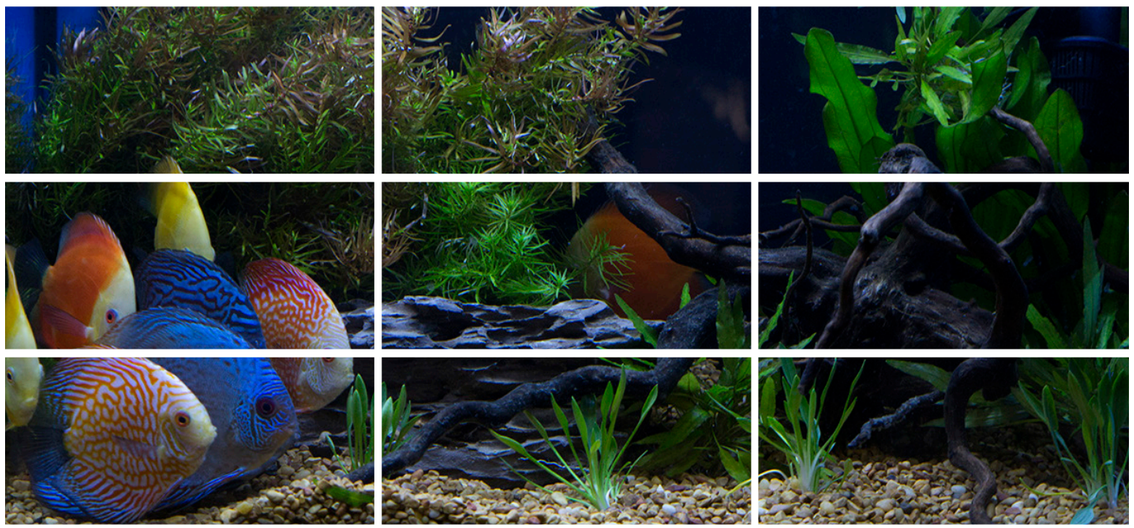
The Sweet Spots of the Rule of 3rds, are the 4 intersections in the center of the subject matter



Place the main focal point of your decorations on one of the sweet spots. You want to try and avoid symmetry with in the squares



Improper design when following the Rule of Thirds, All decoration are crowded in the center, not giving a natural flow to the layout



you are using live plants, be aware of the maximum size so you can make sure to leave some open space.

Backgrounds

With careful planning, you can use the back of the tank to supplement the visual effect of your aquarium. From sunken ships to natural rock formations, the right background can make or break the theme. As with most pieces of equipment, backgrounds are much easier installed before adding water to your aquarium. There are several types of backgrounds you can choose from.

Non adhesive

The classic backgrounds that have survived through the years and continue to be a staple in all fish stores are non-adhesive. They are easy to install on the outside of the back pane of your aquarium and allow you to be able to change it out easily. These backgrounds are usually either precut or on a large roll that can be cut to size and attached simply with a bit of scotch tape.

If you have chosen a background that has an image, there are products on the market that you can apply that will act as a gel and make the image stand out. The only downside to these is that overtime they will become faded and even with the gel you will start to see water trails that get in between the background and the glass. Overall this is still a great choice for most home aquariums.

Adhesive

Another staple in the hobby (but more common in the commercial world of fishkeeping) are backgrounds that will adhere to the outside of the glass. There are a couple of colors available from bright blue to black but none with images. The benefits of these backgrounds is that they are fairly durable, can last several years as well as prevent water spots on the back. The challenge? Unless your aquarium is easily accessible on all sides, you can quickly find yourself in a sticky situation if you try to do install this background on an aquarium that is already set up. Instructions are offered and once you have the hang of it these backgrounds are easy to use.

Painted Backgrounds

If you are more of a DIY person, you might be interested in painting your own background. This obviously needs to be done on the outside of your aquarium and is best done before anything else when you still have a completely empty tank. Depending on your artistic skills, a painted background could be anything from a solid color to an ornate underwater scene.

Synthetic 3-D

If you have sought out inspiration on the internet, you have probably seen many aquariums with realistic backgrounds. These can be as basic as simple slate to dramatic rocky outcrops and tree trunks. There are many options available and if you order them from the manufacturer they are highly durable and exceptionally easy to install. If you are brave enough to try to create your own background, you can find a number of instructional videos and articles online. Be careful what you use as a bonding agent as many of them can alter the pH or even release toxic substances into your aquarium.

Abstract Backgrounds

Sometimes there is just not a commercial background out there that fits your vision. There are several creative ways that you can create your own sunset or blackwater riverbank. Many of them are manipulated using lights and a white background which can give you the illusion of different seasons or times of day. These are used predominantly for pictures and most are not as practical as one of the other traditional options. Research what is going to work best for you for the place that you are installing your aquarium before planning on using this method.

Aqueon Ascent 20 Gallon Frameless Aquarium

7 SETTING UP AN AQUARIUM

It cannot be stressed enough how important it is to research and prepare before buying fish (or any animal, for that matter). You need to know what you are getting into and be confident that you're able and willing to provide everything your fish need.

At some point, though, you've done your research, decided on the goals for your aquarium, bought all of the equipment, and have a pile of equipment ready and waiting for you. What do you do now?

Double Check Your Supplies

One of the most frustrating situations you can find yourself in is thinking you have everything ready to go, start putting the pieces together, and then find out that you are missing a key component. Double check now to save yourself from that headache.

Below is a quick review of equipment and supplies, most of which we've already discussed. See Chapter 4 for a more in depth look at equipment for your aquarium.

- ❑ ***Tank*** - Getting the largest tank your space and budget allows will give you the most flexibility for stocking, helps provide a healthier and more stable environment, and will be more satisfying in the long run.
- ❑ ***Stand*** - Water and rocks are heavy! Make sure your stand can support that weight, which typically means choosing a stand made specifically for aquariums. Other furniture is risky and should often be avoided.
- ❑ ***Substrate*** - Generally speaking, a layer roughly one inch thick should be fine for most aquariums. To estimating how much you will need, start with one pound per gallon of water. Different tank dimensions will determine the exact amount you need, though.

- ❑ ***Filter*** - Most tanks will need a filter, and all tanks will be improved by one. Whether you get a hang on back, canister, a sump system, or your tank has built in filtration, make sure it's strong enough for your tank and you know how to use it. If you're concerned about whether your filtration will be strong enough, err on the side of going stronger. It's nearly impossible to over-filter your aquarium.
- ❑ ***Heater*** - The majority of fish come from tropical environments and need water warmer than room temperature. If you're choosing coldwater fish, such as goldfish, a heater may be optional. Make sure it's strong enough to keep your aquarium temperature stable. Consider using two smaller heaters instead of one stronger heater for some additional protection in case it stops working.
- ❑ ***Lights*** - Unless you're trying to keep aquatic plants or live corals, the light you choose is going to be for your enjoyment. The more light you have, though, the more likely you are to have trouble with algae. Try to choose lights that provide good visibility without fueling too much algae growth.
- ❑ ***Water Treatment Materials*** - If you're very, very lucky, then you have access to water that exactly matches what your fish will need. If you're like most aquarists, though, you'll need to do something to prepare it for your fish. A dechlorinator that neutralizes both chlorine and chloramine is a must. You may need to add a buffer to control the pH or hardness. Or you may want to use an aquarium salt mix.
- ❑ ***Test Kits*** - Being able to monitor and control pH, ammonia, nitrite, and nitrate is vital to being successful. Try to get a high quality test kit that can reliably and precisely measure these parameters. You may also want to test for other parameters as well. Liquid test kits are a little more expensive but will last for a very long time and tend to be less prone to humidity damage and loss of accuracy like the strips.
- ❑ ***Hardscape*** - Hardscape typically refers to driftwood and rocks you use in your aquarium, but you can expand that to include any non-living decorations. While well-chosen hardscapes can help your fish feel comfortable and secure, what you choose is often largely determined by your personal preferences. Keep in mind, though, that some rocks can alter the pH of your aquarium.
- ❑ ***Plants*** - Live plants can provide a wide range of benefits, but they do come with a distinct set of challenges. Unlike fish, plants can be added as soon as you set up your aquarium and they will help reduce or, in a heavily planted aquarium, can even eliminate the nitrates that will build up.
- ❑ ***Plant Equipment*** - If you're going to be setting up a planted tank, you need to determine what additional equipment (if any) you may need. Do you need a CO2 system or pH drop checker?
- ❑ ***Powerhead*** - Sometimes you may want more current in your tank than your filter alone will provide. Powerheads will allow you to increase the amount of water flow in your aquarium and avoid having "dead" pockets of water without circulation where detritus can build up.
- ❑ ***Air pump and stone*** - Most filters will provide enough aeration that an external air pump isn't necessary, but many people like having them. Even if you don't need one, there's little if any chance of it causing any harm in your tank.
- ❑ ***Background*** - You may decide that you do not want one, but if you do it is much easier to install it before having water in the tank.
- ❑ ***Gravel Siphon*** - A gravel siphon is good to have on hand even if your tank is not yet cycled. Most of them are fairly inexpensive and will be an essential part of your aquarium maintenance. If you have a large tank or would like to make water changes extremely easy there are some brands that you can actually attach to a sink.
- ❑ ***Miscellaneous Odds and Ends*** – It's the little things that you may come home without that you may find yourself missing. Air tubing, checkvalves for air tubing, thread seal tape, etc. These are all very easy things to overlook when you are purchasing your entire set up and can be frustrating to not have when you get home.

Where to Put Your Aquarium

You may already know exactly where you want to put your aquarium, or you may still be trying to figure that out. If you don't already know where it's going, you're in a bit of luck. For the most part, there are few places that won't work for your aquarium. Put it wherever you are most likely to see and enjoy it.

But there are some considerations that will help you avoid problems.

Avoid Windows

While this is not absolutely true all the time, it's not uncommon for aquariums placed directly next to a window to have algae problems. It's generally best to avoid setting up your aquarium where it's going to receive a lot of direct sunlight.

Algae growth, like plant growth, is directly related to the balance of light, nutrients, and carbon dioxide. When these factors are perfectly balanced, plants thrive. If that balance is skewed, particularly by an overabundance of light and/or nutrients, algae is very likely to grow rampantly.

It's easy to underestimate how much light is supplied by direct sunlight. It's far more than almost any aquarium light. Unless you are meticulously planning for that amount of light, it is almost guaranteed that an aquarium sitting next to a window that gets a lot of direct sunlight is going to have a lot of algae problems.

There are some instances where placing a tank next to a window may not cause problems. Perhaps you have a lot of trees that keep your window mostly in shadow. Or maybe you live in a big city high-rise where the building next to yours block out a lot of direct light. But unless you are confident in your ability to keep your tank free from algae, it's probably best to put your aquarium somewhere else.

Think Convenience

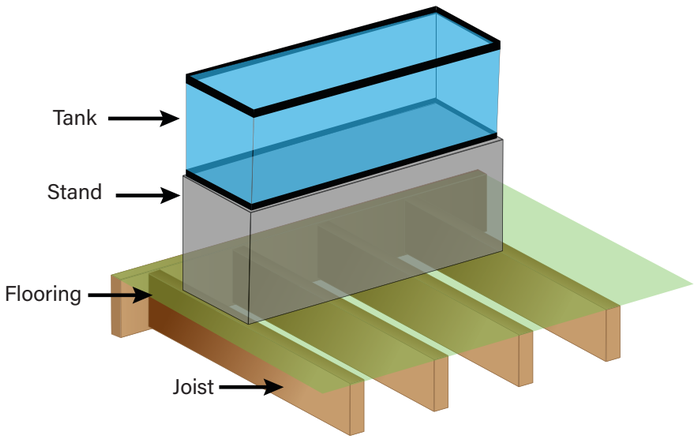
Whatever type of setup you choose to create, there are going to be periods of time that require a fair bit of work and effort. If you have a poorly planned location for your aquarium, this could potentially lead to a huge amount of frustration fairly quickly.

Think about how you are going to perform routine maintenance such as regular water changes. Are you planning on filling up your tank using water from the tap in your house? If so, is there a tap close to where you're going to put your aquarium, or are you going to have to run a hose a hundred feet? Are you going to have to buy water? If so, is your tank going to be fairly close to your entrance or will you have to carry it through the house? When you drain your aquarium, how are you going to dispose of the water? Is there a drain close enough you

can run a siphon to or will you have to drain into a bucket and then carry the water out? Imagine performing a 50% water change on a 225 gallon aquarium you're keeping in the basement if you don't have a drain down there and have to carry the water up the stairs in 5 gallon buckets!

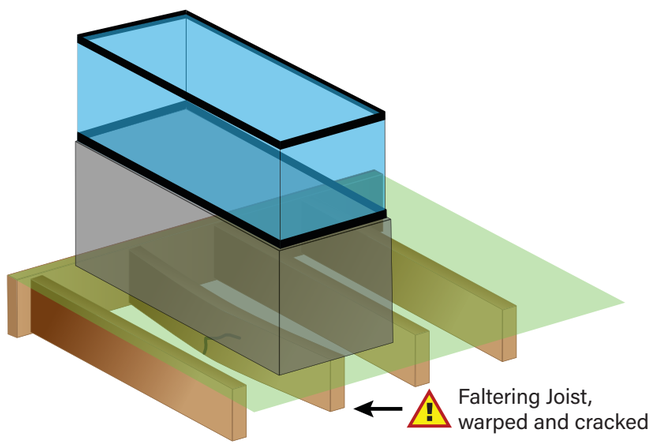
Also think about moving your aquarium in and then (eventually) back out again. Is it worth the extra effort to have to squeeze and finagle it through tight turns and doorways to get it into a specific room? Ideally, you'll pick a room with easy access that allows you to fill up and drain the aquarium with a minimum of manual work.

PROPER PLACEMENT



Weight of tank, stand and water
disperesed across multiple floor joist

POOR PLACEMENT



Weight of tank, stand and water
all being held by one floor joist

Do You Need to Worry About Your Floor?

Water weighs about 8.5 pounds per gallon. Add in the weight of the glass, substrate, and any additional rocks or decorations and you can estimate your total weight to be around ten pounds per gallon. The most popular size aquarium has long been the standard 55 gallon aquarium, which is going to weigh around 550 pounds.

It's easy to be concerned with the weight of your aquarium and whether or not the floor in your house will support it. Fortunately, most of the time you don't need to worry about it. Unless you're going larger than about 125 gallons then odds are you won't need to even think about it.

Whether or not your floor will support your tank's weight is determined by what's below the floor itself. If it sits directly on the concrete foundation, as is often the case in basements and garages, you can probably put just about anything you want on it without having to worry.

Most houses are built with joists, which are long wooden beams that are spaced out with the floorboards resting on top of them. The joists themselves are usually extremely sturdy, though the age of the house may impact how strong they are. The older the house, the higher the chance that some sort of damage has weakened the joist. Conversely, though, older houses are also more likely to have thicker, harder beams that may give more support.

How much your tank weighs and how it's distributed on these joists will determine how well the floor will hold it. If the tank is sitting perpendicular to the joists, the weight will be spread out between a number of different joists, making the tank more secure. You may run into trouble, though, if your tank is sitting parallel between two joists with only the floorboards supporting it. The closer your tank is to where the joist is connected (generally at a load bearing wall) the more secure it will be. Exceptionally heavy tanks that are situated near the middle of the joists may, over time, cause the joist to bow or eventually even break.

For the most part, though, the typical tank will never have to worry about this. It would be rare that a 75 gallon aquarium would run into problems, and even 125 gallon tanks are typically fine. But if you are willing to make the investment for an aquarium large enough to hold several hundred gallons of water, it would probably not be a bad idea to hire a structural engineer to inspect your floor to determine if you need to add additional support.

Keep It Level

There are a lot of debates about how much of an impact not being level can have on a fish tank. Some people will argue that a tank not being level puts it at an increased chance of cracking or breaking its seam (leading to all of the water in your tank gushing out onto your floor). Others will argue that even relatively unlevel tanks don't create any forces that are outside of the accepted tolerances for the materials (the glass and silicone) the the tank is built with.

Wherever you stand on this debate, it doesn't hurt to be safe. When setting up your tank, find a place that is flat and level. If you set your tank stand somewhere and it wobbles, either move the stand somewhere else or add some sort of support such as composite plastic shims to stabilize it.

Putting It Together

Now that you've decided where you want to put your aquarium and know where it's going to live, it's time to start putting everything together and get your tank running.

Add Substrate and Hardscape

Before you add anything to your tank, you should rinse your substrate very thoroughly. With the exception of a few substrates, when you first add water, it will become very cloudy. Using a large bucket, vigorously rinse the substrate until the water becomes completely clear. Depending on the substrate this can take a lot of rinsing, but you can speed up the process by rinsing smaller portions at a time.

Adding the substrate and hardscape should generally be done more or less simultaneously. Depending on how you're decorating the tank, you'll potentially have at least some pieces of your hardscape that are forming a foundation for other pieces. Often, these foundation pieces are best placed directly onto the bottom glass of the aquarium to prevent fish or other animals (crabs, snails, etc) from digging under it and causing a collapse. A large pile of rocks falling in your aquarium can severely damage or even destroy the glass.

With the foundational pieces of hardscape in place, add the (well rinsed) substrate. Most people will aim for around an inch of substrate, though you may be happy with more or less than that. Smooth the substrate as well as you can. You can gently slope the substrate towards the back of the tank, putting less by the front glass and more in the back for a better visual appearance to the tank. With the right foundation layout and substrate use, you can create a sense of depth and dimension in even the smallest of tanks.

Add Decorations

If you have any additional decorations or want to add plants to your tank, they can be added after your substrate is in place. At this stage, it can help to add just a little bit of water to your tank. Adding just enough to reach the top of the substrate, or filling an inch or two above your substrate, can help make it easier to place plants and decorations where you want them.

If you're adding additional layers of hardscape, such as larger piles of rocks to create territories for African cichlids or additional driftwood, doing it after adding all of the substrate is the easiest time. Work up in layers, adding gradually more water so that it always comes just above the most recent additions. As you build up, try to build on top of at least three stable points, don't rely on the side glass of your tank for support (you may crack the glass!), and wiggle each rock gently until it either "locks" in place or is stable enough to continue to build upon.

Add All Equipment

Realistically, equipment like your heater, filter, air stones, and diffusers can all be added either before or after you finish filling up your aquarium. Adding them before can have some advantages, though.

It can be easier placing pieces of equipment such as heaters and air stones when you're not elbow or shoulder deep in water. Depending on how much water you put into your aquarium, you may end up overflowing the tank when you put the equipment in if you fill it first.

Think about how the water will flow around your equipment when putting it all in place. You want to place your heater where the water current will distribute the warmer water throughout the tank. Place powerheads where you can ensure that there are no dead spots in the tank where there is not any current flowing.

Finish Filling Tank

At this point, you should finish filling up your tank. Be very careful when adding water because it's very easy to mess up plants, substrates, and decorations if you add the water too fast. You can place something like an empty substrate bag on the bottom of the tank to pour the water onto so you don't wash away the substrate. Or you can use a flat plate for the same purpose. If nothing else, use your hand or slowly pour the water onto a rock or decoration to reduce the force of the incoming water. At this time, you should make sure to add water into your filter. Virtually all water pump designs require them to start by actually pumping water. If there is only air in the pump, it won't be able to create enough suction to pull water from your tank into the filter. And if the filter runs without water in it for too long, it's most likely going to overheat and seize up, possibly destroying it.

Add Light

You might wonder why you'd not add your lights with the other equipment. In reality you actually could, but often the light fixture will just get in your way, making it more difficult to add the other equipment and the water to the tank. It's easiest to wait until you have everything else ready before worrying about the lights.

Test Everything

With all of your equipment in place and ready to go, start it up and let your equipment run for a while to make sure everything working correctly. Make sure that your filter is working the way that it should and that your heater is set to the right temperature for your fish. If you have anything running on a timer (such as lights or an automated CO2 system), make sure it's also working correctly.

Prepare Your Water

With your tank fully up and running, prepare your water for fish. Treat it with a dechlorinator to neutralize any chlorine or chloramines that may be in the water. Make sure that pH and water hardness matches what the fish you want to keep are going to need. If you are keeping African Cichlids, make sure your pH has a chance to rise to the appropriate levels. If you're keeping brackish or marine fish, make sure your salinity is correct.

Are You Ready For Fish?

Maybe. Or maybe not. Remember, patience is the number one factor in aquarium success.

Now is the time for your tank to cycle (see Chapter 3). If you're doing a fishless cycle, you need to wait for it to finish before adding fish. If you're doing a fish-in cycle, only add a very few fish and ensure that you're not creating a situation where you expose your fish to toxic levels of ammonia.

8 FEEDING YOUR FISH

One of the most basic parts of fishkeeping, which can be easily overlooked, is feeding your fish. It's very easy to grab a bottle of food off the shelf of your local fish store, go home, and drop a little bit into your tank. But are you feeding your fish the best options? Are they getting enough food? Is each fish's needs getting considered? While feeding fish isn't particularly complicated, being aware of certain characteristics can help you keep your fish in prime shape.

Fish Diets

In the wild, most fish are opportunistic feeders. If they see something edible, they're going to eat it. This characteristic is largely born out of necessity. After all, when you live in a relatively isolated river or lake you can never be entirely sure when your next chance for a meal may be. This is also why fish seem to be constantly begging for food, eagerly reacting to your dropping a few pellets or flakes into the tank.

But just because they'll eat anything offered doesn't mean that all foods are created equally.

Like all animals, fish have evolved to eat specific organisms. Their entire body shape, mouth anatomy, and digestive tracts are designed to best consume certain types of food. While different foods can work in a pinch, long term consumption of the wrong type of food can lead to significant problems. Issues like Malawi bloat in mbunas and hole in the head disease in oscars are primarily the result of being fed the wrong diet.

When you're choosing what food to feed, start by looking at your fish's primary diet in the wild.

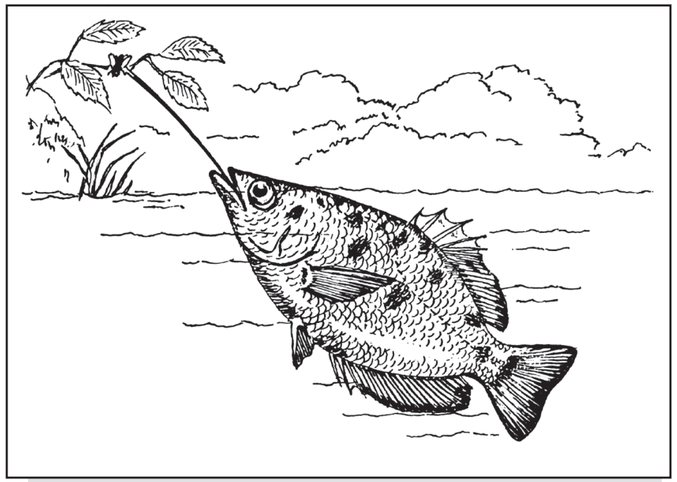
Herbivores

Pretty much every fish that is sold as an algae eater is a herbivore. Otocin-

clus, flying foxes, and certain plecos are all going to eat primarily plant matter. Goldfish, silver dollars, mollies, and several other common species also have at least a significant portion of their diet that comes from plants. Perhaps the most surprising group of herbivorous fish are the mbunas. Almost all of them feed primarily on plants and don't do well when given more animal protein.

There are a variety of plant based foods that are commercially available. Most are made from plant material such as algae, spirulina, kelp, or seaweed, though you may find other food bases as well.

One thing to keep in mind is that while it's easy to think that your herbivores will get all the food they need from algae growing in your tank, often this won't be enough. Even if you do have a fair bit of algae for them to graze on, it's a good idea to offer them additional food options to give them variety and ensure they are not underfed.



An artist depiction of an Archer Fish spitting/shooting a fly off a branch.

Insectivores

The stereotype is that big fish eat little fish. But what do little fish eat? If they don't graze on algae and plants, most of the time they're going to eat insects and insect larvae.

Pretty much all small fish such as tetras, danios, and bettas will have a significant portion of their diet come from tiny food sources such as insect larvae. There are also some larger fish that are notable for eating insects. Perhaps the most amusing example are archer fish who spit water to knock flies and other insects into the river in order to eat them. Arowana are also known for jumping several feet out of the water to catch insects.

Carnivores

Carnivorous fish are those that eat other fish, crustaceans, or any other animals aside from insects. The most obvious example are going to be large fish that readily eat smaller ones. Gar, larger catfish, and predatory cichlids such as pike cichlids are all carnivorous. Similarly, there are many fish that search for crawfish, crabs, shrimp, and other crustaceans as their food of choice.

There are many commercially available foods that are designed primarily for carnivores. These will often include proteins such as fish meal, krill, brine shrimp, shrimp, and more.

Omnivores

In reality, because of their nature as opportunistic feeders, most fish fall somewhere in the omnivore category. They may skew more towards one category than the others, but will nevertheless eat a varied diet. Most of the fish food options available are designed for omnivores. This is one of the reasons why it's easy to get away with grabbing just about any bottle of food off the shelf, even if it's not ideal for every fish.

Plecos

Plecos are commonly misunderstood when it comes to feeding. Many people think of them as being algae eaters, and while this is true for some species, it's only partially correct for most.

While many plecos will scrape off and eat algae, they generally eat what is called *aufwuchs*, a German word that refers to all of the organisms and biofilm that grow on surfaces underwater. In addition to algae, this includes a variety of crustaceans, insect larvae, and worms that live in the algae as well as a wide range of microorganisms. Plecos scrape all of this off the rocks and driftwood in their environment.

In an aquarium, it's best to provide plecos with plenty of driftwood for them to feed off of while also supplementing with alternative foods such as algae wafers and fresh veggies. One thing to keep in mind, though, is that through all of this scraping of the wood plecos tend to create what is essentially sawdust in your aquarium. If you are keeping plecos, particularly some of the heavier feeders, they're likely going to create a fair bit of mess that you will need to regular siphon out of your tank.

Types of Fish Food

In addition to what fish food is made of there are several different ways that they can be "prepared" for feeding your fish. Broadly speaking, you can break these down into a few categories: processed (including flakes, pellets/granules, and wafers), freeze-dried, frozen, and live.

There are tradeoffs to all of these options. More heavily processed foods are typically cooked in some way, which can help increase their shelf life, preventing them from rotting as quickly. But the heat from the cooking process can break down nutrients such as vitamins and proteins, reducing the overall nutritional value of those foods. On the other hand, processed foods can be fortified with a range of ingredients to overcome nutritional deficiencies. Live and frozen foods may not have the problem with nutrients breaking down, but you may not be able to provide a well-rounded diet, leading to nutritional deficiencies.

Flakes

Flakes are perhaps the most common and traditional food option you have for feeding fish. Flakes are heavily processed and generally contain an enormous variety of ingredients, allowing them to be very well rounded and offer a complete nutritional profile. You can find flakes that are designed for pretty much any group of fish, though most will be designed for omnivores. Flakes are particularly popular for smaller fish because the larger flakes can easily be broken down for small mouths.

Aqueon Goldfish Flakes

There are a couple of shortcomings when it comes to flake foods, though. Because of how thinly pressed they are and the ease with which they'll break down, it doesn't take long for them to essentially dissolve into the water such that your fish can't eat them anymore. When this happens, the uneaten food end up rotting and releasing ammonia. You need to be very careful not to overfeed so that your fish will consume all the food you offer. Additionally, because of the small size, flake food is often not accepted by larger fish. It's unlikely that you'll get a big cichlid to pay any attention to flakes. However, if you have the right fish and are careful with your feeding, you can be very successful with flake foods.

Aqueon Shrimp Pellets

Pellets

For many aquariums, pellets are likely going to be the best option for feeding fish. They are created in much the same way as flakes, allowing them to have a wide range of ingredients and a complete nutritional profile. You can also find pellets designed for almost any type of fish.

Pellets come in a wide range of sizes, ranging from tiny pellets the size of a grain of sand to large balls a quarter of an inch or more in diameter. This allows you to find a size that will be appropriate for any size fish you keep. You can also find "granules" which are essentially small pellets, just more irregularly shaped.

In addition to different sizes, pellets also come in a range of different densities, allowing you to find pellets that float on the surface, immediately fall to the bottom of the tank, or slowly sink. This allows you to target fish that feed in different swimming zones. Finally, pellets are much sturdier than flakes, meaning that they won't rapidly break down in the water, giving your fish more time to eat them.

Aqueon Algae Rounds

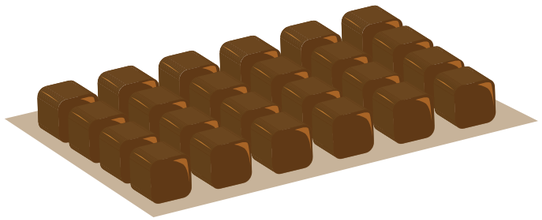
Wafers

Wafers are essentially just pellets that have been flattened into a disc like shape and are generally dense enough to sink to the bottom of the tank. Perhaps most common will be algae wafers designed for plecos and herbivorous scavengers. You can also find wafers designed for bottom dwellers such as cories and other catfish.


Aqueon Betta Treat
Freeze Dried Bloodworms

Freeze Dried

Certain food organisms, most commonly tiny crustaceans such as krill, mysis, and brine shrimp as well as blood worms, are available in a freeze dried form. These foods have the benefit of giving you a food that can be stored for a long time at room temperature without going bad. While the freeze drying process will result in losing some of the nutritional value, it won't be as significant as the more heavily processed foods. However, they are also generally offered with one organism (sometimes you'll find a few mixed together), so you are not going to get as well rounded of a food source as you would with flakes or pellets. As such, many people use freeze dried foods as a treat or supplement to add variety to other food options.



Frozen

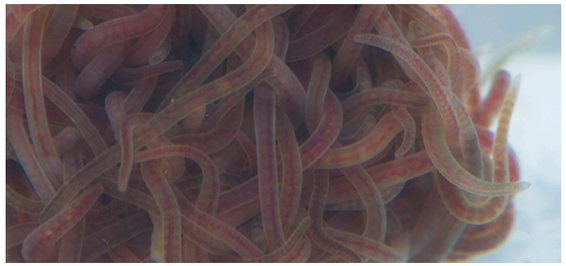
Aside from feeding fresh, live foods, frozen foods will retain the most nutritional value out of the different food options. You can find a wide range of frozen foods for all sizes of fish and for all feeding groups. There are a number of frozen foods that contain blood worms, black worms, brine shrimp, krill, squid, shrimp, fish, and many other food options as well as blends. You can find tiny foods such as cyclops that are suitable for fry and filter feeders or large foods such as whole fish or shrimp for your larger fish.

Frozen foods give you the advantage of having the nutritional value of fresh foods while being able to easily store them and not have to worry about keeping them alive. You do need to be careful to ensure that you are giving your fish a variety of different options so that they don't develop any nutritional deficiencies, but that is easily done by either using multiple frozen foods or by combining them with other processed foods.

Live Foods

Live foods are one of the more challenging food types to qualify. On the one hand, they've never been cooked or processed and offer unaltered nutrients. Live foods are what every wild fish has evolved to eat. Flakes and pellets don't naturally exist. On the other hand, live foods introduce the additional challenge of having to keep something else alive. Whether those foods are brine shrimp, black worms, feeder fish, or something else, they have their own needs that have to be met.

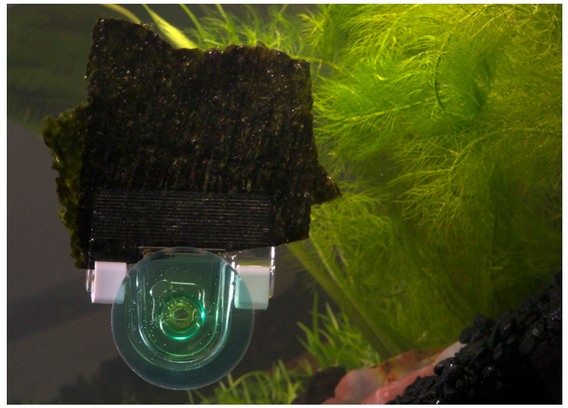
The biggest challenge with live food is that, while it does try to emulate how the fish eats in the wild, natural food chains are immensely complicated and almost impossible to replicate in captivity. The nutritional value of a fish is not just determined by the biology of that fish, but also the organisms it ate and the cumulative nutrients of all the steps in the food chain up to it. Additionally, wild fish often eat a wide range of food items, and without a robust web of foods it's easy to run into nutritional deficiencies.



With live foods, you also have to be concerned with the overall health of the food item. For example, feeder fish are often kept very densely stocked for their entire lives and are not always given the same level of care and attention that fish destined to become pets are. Few people set up month long quarantines for their feeder fish. Frequently introducing new fish to your aquarium that can't be guaranteed to be completely healthy increases the risk of introducing pathogens to your aquarium. You may never run into any problems, but there's always a chance.

All this considered, there are times that you will want or need to feed live foods. A handful of large predatory fish will only eat live feeder fish (fortunately, most species can be trained to eat frozen or even pellet foods). Some small, sensitive species can also be picky about what they are willing to eat, requiring foods such as live brine shrimp or live insect larvae. More commonly, live foods are often offered to pairs of fish in an effort to "condition" them and encourage them to spawn.

The bottom line with live food is that while there is a time and a place to use them, if you can get away with using another alternative, you should probably try to do so. Almost every fish (even some of the most picky eaters) can learn to accept frozen foods if you are patient with them, and many species have no issues at all with commercially available dry foods. If you do want to use live foods, try to use them as treats and supplement them with other food types. Variety is important with any food type you choose.



Fresh Veggies

For herbivorous and omnivorous fish, you can also offer them a mixture of fresh vegetables. Cucumbers, zucchini, lettuce, and broccoli stems are popular options to give to aquarium fish. Some of these (cucumbers and zucchini) you can feed raw, while others (broccoli stems) can use a bit of boiling to soften them up a little bit. If you have fish that struggle with constipation, boiled peas are a common and effective food to help add fiber to their diets. Additionally, you can find strips of dried seaweed (such as nori) and kelp. Several companies make clips attached to suction cups that will hold them in place in your aquarium.

Ensuring Your Fish Eat

What kind of food you should be offering your fish is definitely important, but it's also only part of the equation. You need to make sure that all of your fish are getting enough food and that their feeding behaviors are being considered.

How Much Should Your Fish Eat?

The biggest question when it comes to feeding fish, and one of the more common debates when it comes to keeping fish in general, is how much should you be feeding your fish?

Because they are opportunistic feeders that are constantly on the search for food in the wild, fish in aquariums often seem to be constantly hungry and searching for food. It's easy to look at this behavior, think they're "begging for food" (and, in fairness, maybe they are) and want to feed them more.

Many people overfeed their fish because of this. Overeating is not good for any animal, and consistent overfeeding can lead to problems. For example, there are a number of fish that are susceptible to diseases originating from excess fat in their livers that is the result of feeding too much food (particularly foods with the wrong nutritional profile). Overfeeding will also increase the overall amount of ammonia being released into your water and increasing the amount of work you have to do to maintain good water quality. A common saying is that a hungry fish is a happy fish, and while that's only true to a point, keeping that in mind can help you avoid overfeeding your fish.

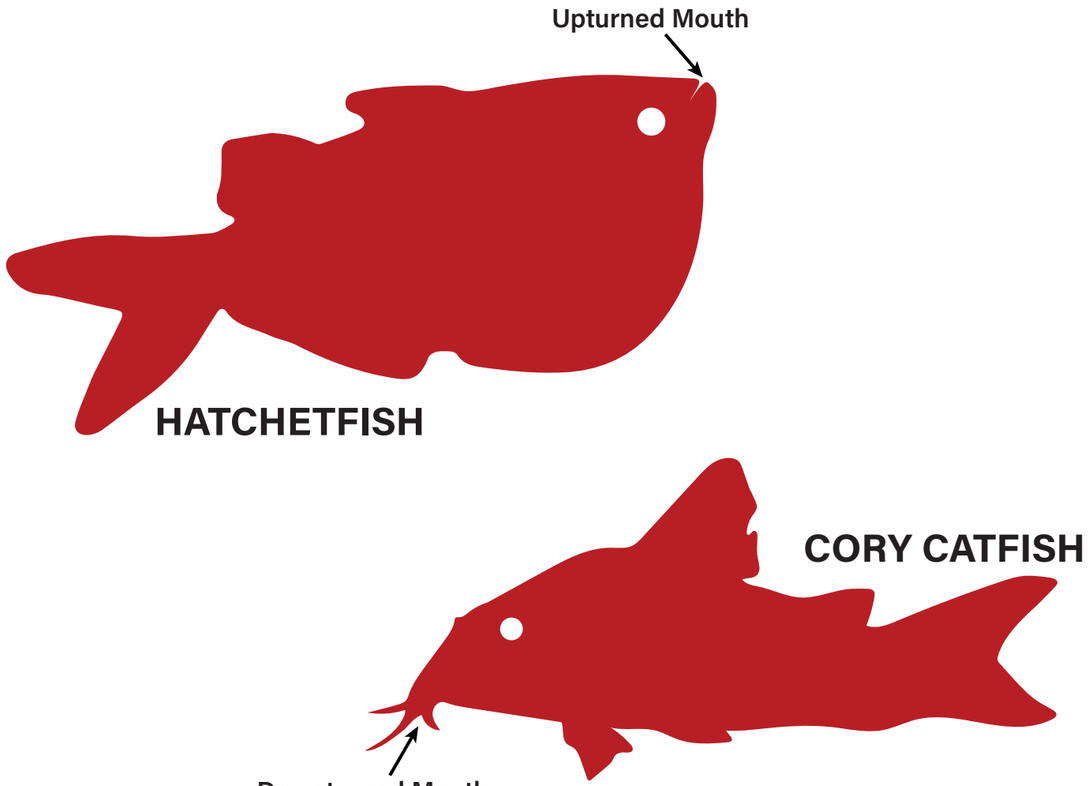
How much to feed is going to depend on what fish you are keeping and what foods they are eating. If you're feeding your fish fairly large live or frozen fish you may not need to feed them more than once every week or two. Some small, active fish that only eat tiny foods should be fed at least a couple of times a day. While it never hurts to look up recommendations based on the exact species you're keeping, for your standard aquarium fish that you're feeding commercially available fish food, you are probably fine feeding them once or twice a day what they'll eat within a minute or so.

Feeding Zones

Different fish hang out in different levels of your aquarium. Naturally, this means that they generally prefer to eat in those areas. You should try to use food that will be easy to find where they want to eat.

Hatchetfish, for example, stay at the top and will pretty much only eat food that is above them. While they may swim lower to get food floating in the water, if it sinks to the bottom it's highly unlikely that they will go down to get it. Cory catfish are constantly searching the bottom for food, so sinking pellets are ideal for them.

Fortunately, there are prepared foods that are designed for all different feeding zones. There are pellets that sink, float, and slowly sink (allowing mid-water species some time to eat before the food reaches the bottom). Flake foods will often float at the top until they absorb a little water, after which time they will start to sink. But because flakes are so light, they will often be carried by the currents in your tank and stay suspended for a



while. You do have to be careful, though, that they aren't quickly sucked up by your filter.

Shy vs. Assertive Eaters

Different fish feed with different levels of enthusiasm. Tiger barbs, for example, are voracious when they are fed. The entire school will instantly and eagerly grab as much food as possible the moment you toss some into the aquarium. Other fish are much more shy and try not to compete for food. Black ghost knife fish will generally hang back and eat food when there aren't other fish trying to get to it.

Combining the two types of feeders can be challenging. While it may be easier to try to avoid mixing shy and assertive eaters, there are some techniques you can try if you have both. Often, the shy fish are more likely to eat if you feed them at night after you turn the lights off. A lot of fish are diurnal (meaning they're active during the day and sleep at night), so the more boisterous fish may be less active and the shy fish more comfortable when they don't feel exposed under bright light.

You can also try spot feeding certain fish. You might offer a floating food for the more active eaters and place other food right next to where the quieter fish hang out. This can be done as simply as using your hand to release the food in those spots or you can use other tools. Some keepers will use a skewer to target feed frozen foods or some sort of tube to drop pellets exactly where they want them.

Ensuring that all of your fish get the right amount amount of the right kinds of food is one of the most important steps to keeping them healthy and thriving.

9 PLANTED TANKS

As we have already seen, there are a number of tank styles you can choose to set up. While each has its own considerations, there are challenges unique to planted aquariums that are found nowhere else in the hobby. From new techniques and concepts to additional expenses to the potential for spectacular disasters, these challenges require the keeper to spend more time planning, learning, and maintaining than most other freshwater aquarists.

You might wonder why anybody would want to deal with all of this just to have some plants in their aquarium. But the benefits of a planted tank can be well worth the effort.

Why Keep Plants?

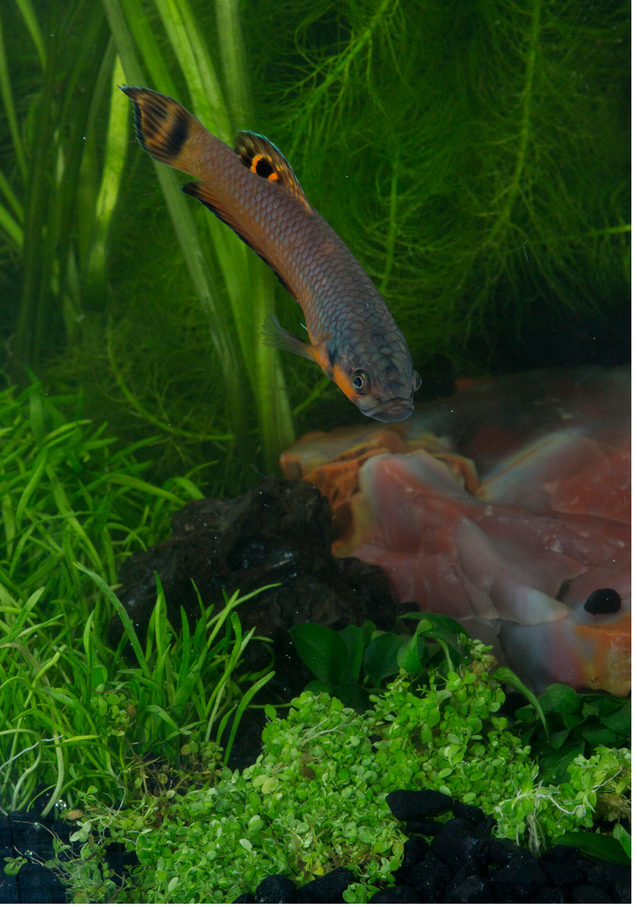
Natural Water Purifiers

Like all living things, plants need food to grow and survive. Water and light is not enough. Unlike animals, though, plants (well, most of them) can't actually "eat" something else to gain these nutrients, so they rely on other organisms to break organic matter down into a form they can use. The most common and abundant nutrient that plants use is Nitrogen. Fortunately for us, almost everything else in an aquarium is constantly creating nitrogenous waste.

Aquarium plants can utilize ammonia and nitrite, but the beneficial bacteria in a well cycled tank will generally break it down before the plants have a chance to. Nitrates, on the other hand, are abundant in our tanks and are readily consumed as food by plants. With the right combination of plants and fish, it's entirely possible to have an aquarium that never builds up any measurable amount of nitrate.

Creating a Biotope

Many hobbyists, after keeping fish for a certain amount of time, will want to recreate habitats from specific parts of the world. These biotope tanks will use



only species of fish and plants native to that habitat and decorate the tank as though somebody took a slice out of nature and brought it into their home. Biotopes can bring the ultimate natural experience to an aquarist. See Chapter 6 for more information on biotopes.

Adding Beauty

For a huge number of planted tank keepers, the decision to add plants comes down to quite simply wanting to add some extra beauty to their aquarium. There are many different styles of aquascapes that can be created to reflect the personality and tastes of the aquarists, whether that is creating an underwater garden, shaping a living landscape, or simply adding color and textures that would otherwise be missing from an aquarium. The possibilities of what a creative and motivated aquarist can create are quite literally endless.

The Needs of Plants

Like all living things, plants have specific needs that need to be met in order to survive. For animals, those requirements are generally food, water, and air. Similarly, plants need food, water, air, and light in order to live. Of course, being aquatic plants that are living in a fish tank underwater, their need for water is going to be met by default. That just leaves food, air, and light to be concerned about.

The key to successfully keeping a planted aquarium is finding the balance between these three needs. Missing that balance is when you run into significant problems.

Let There Be Light

The first need that should be addressed in a planted tank is light. Through photosynthesis, plants will use the energy from light to convert nutrients into fuel for growth. As a result, light is the driving force which controls everything else.

In nature, light is plentiful. Day after day, the sun supplies more light than the plants will ever be able to use. Artificial lights, such as the ones we use for our aquariums, are, by contrast, puny. While our eyes are sensitive enough to accommodate this weak light and hardly notice a difference, the amount of energy it can supply plants is not comparable to what they would receive outside.

However, this is not necessarily a bad thing.

Anybody who has ever put an aquarium next to a window can tell you how much of an algae problem that amount of light can create. Theoretically, one could use the natural sunlight from a window as the primary light source for a planted tank, but doing so without being overwhelmed by algae would be extremely challenging. There are many styles of aquarium light and each style comes in a range of brightness levels. How can you decide what light to choose? You need to look at the needs of the plants you are trying to grow, the other equipment you're willing to invest in, and how much work you're willing to put in.

Most people separate plants into three categories based on how much light they need to achieve the best growth. These categories are, creatively, called low light, medium light, and high light.

However, plants do have some flexibility. Some plants that are classified as low light can do fine in high light conditions, often just growing faster than they would under low light. Conversely, some high light plants will slowly grow under low light conditions, though they may not achieve the colors they normally would.

Fluorescent Lights

For many years, the most common aquarium lights have been fluorescent. They are readily available, relatively cheap, fairly energy efficient, and don't put off much heat. And because of their long popularity, experienced planted aquascapers have refined their use.

There are multiple styles of fluorescent lights, which are designated by the letter T followed by a number. T12 bulbs are the oldest style of fluorescent bulb. They have the largest diameter, are the least efficient, and put off the least amount of light. T8 and T5 bulbs are progressively smaller in diameter, more efficient, brighter, and also more expensive. There are also two additional T5 variants, T5HO (High Output) and T5VHO (Very High Output) which are the same size as a T5 but are even brighter still.

Closely related to traditional fluorescent bulbs are compact fluorescent or power compact bulbs. In essence, these are bulbs that consist of multiple fluorescent tubes that have been bent and shaped to take up much less room and are generally able to fit into standard incandescent light fixtures. For their size, they put off much more light than alternatives. This makes them a great choice for small tanks that can't fit a normal fluorescent tube as well as gives the option to put more bulbs (and thus more light) in the same amount of space.

Because they are quite standardized, there are some rules of thumb about what fluorescent bulbs fit into which category. Generally speaking:

- **1 watt per gallon = Low Light**
- **2-3 watts per gallon = Medium Light**
- **4-5 watts per gallon = High Light**

The standard hood that comes with most aquarium kits typically come with one or two T8 bulbs and will most likely be less than 2 watts per gallon, making them only suitable for low light plants. For higher light plants, you'll need to find a specialty hood.

LED Lights

LEDs are becoming increasingly popular choices for many people, and more and more aquarium kits are changing from fluorescent bulbs to LEDs. They are much more energy efficient, put off virtually no heat, have very long life spans, and are rapidly dropping in price.

Additionally, LEDs allow for a wide range of customization in the light spectrum being produced. They can be precisely tuned in to the precise light qualities that will most benefit the plants.

THE PROBLEM WITH WATTS PER GALLON

Using watts per gallon gives you a generalized rule of thumb starting point, but it is nowhere near a complete method.

The first, most obvious problem, is that watts are a measure of the amount of energy being used, not a measure of how much light is being produced. Different bulbs have different levels of energy efficiency, so two different types of bulbs that use the same wattage can put off significantly different levels of light. Old fashioned incandescent lights are very inefficient, so even fairly high wattage incandescent lights will often only supply a low amount of light. Fluorescents are more energy efficient, though there is variability even within the fluorescent family of lights. LEDs are incredibly energy efficient and don't use much power at all.

Additionally, the design and materials of the hood and potential reflectors can dramatically alter how much light is directed downward into the tank. People have discovered that plants they have struggled with will thrive after adding or replacing the reflector in their hood.

Even if you could get some standardization on how much light is produced by a watt of energy, it says nothing about how much light is actually reaching the plants in your tank. As light travels, its strength decreases exponentially, a concept known as the inverse square law of light. As the distance between the light source and an object is increased the strength of the light is decreased by the square of the change in distance.

As a simplified example, image you had a tank that was 12" tall and another that was 24" tall with the light set right at the top of the tank. The bottom of the 24" tank would receive only ¼ of the light as the bottom of the 12" tank. Further compounding this is that the water itself will filter even more of the light, so there will be an enormous variance in the amount of light your plants are receiving depending on where your light is situated (directly on top of the tank vs. suspended some distance above it), how tall your tank is, and how much water it has to travel through.

Finally, the strength of the light is not even the most important quality. Plants have evolved to best absorb specific wavelengths of light, namely in the blue and red spectrums (they reflect green light spectrum, which is what gives their green color). A light that may give off less light but in the correct spectrum may be more effective than a light that gives off more light in a less productive spectrum.

The downside to LEDs, though, is that they are a rapidly changing technology that hasn't reached the same level of standardization as fluorescent bulbs. There are no rules of thumb to determine what strength of bulb is needed for what plant. Depending on the way they're built, two different LED diodes of the same power may put off remarkably different levels of light.

Finding an LED fixture that can support plant growth, especially for high light plants, still largely comes down to trial and error. At this time, the best method is to read as many reviews from others who have tried that fixture as possible.

HOW MUCH LIGHT DO WE HAVE?

For the most dedicated planted tank keepers who want to precisely control their lighting, the best method to know how much light your plants are receiving is to purchase a PAR meter that can be used underwater to measure exactly how much light is penetrating the water. PAR meters can be a significant investment, but for any aquarist who wants or needs this level of precision, there is no substitute.

What, exactly, is PAR? PAR stands for Photosynthetically Available Radiation and is, quite simply, the amount of light energy (radiation) that is available for plants to utilize. By contrast, another measurement for light intensity is Lumens, which measures all of the visible light at a certain point. However, plants don't use all visible light. They mostly use blue and red wavelengths. PAR measures the amount of light within the wavelengths that are used for photosynthesis.

Keep in mind that due to the amount of light that is lost due to distance and the filtering effects of the water that you need a PAR meter that will work underwater so that you can measure how much light is reaching a specific point. What should your PAR meter be reading? A general guideline is that 15-30 should be sufficient for low light plants, 30-50 would be considered medium light, and higher than 50 should work for most high light plants.

Feed Me Seymore

As with all living things, plants need to "eat" in order to survive. By eating, I mean that they have to take in nutrients that they can use to build new cells and grow. If you are running a low light tank, then odds are the growth is going to be slow enough that there will be enough nutrients entering the water column as a result of fish waste, fish food, and what is already present in your water supply. However, if you're trying to increase your plant growth by giving additional light and CO_2, then these nutrients will quickly become depleted.

There are many elements that are vital to plant nutrition, but the most important are Nitrogen, Phosphorus, and Potassium. Many available aquatic plant fertilizers will supply all three of these in a specific ratio. If you want additional control over your plant growth, though, you can add them individually to your tank.

Nitrogen

Nitrogen is the most abundant gas present in the atmosphere, and as such makes its way into many different processes. In an aquarium, nitrogenous waste is often one of the biggest concerns, as ammonia, nitrites, and nitrates are all harmful to fish in various levels. Fortunately, though, in a planted tank, these can all be taken in and used by plants in various levels. Because of the beneficial bacteria that quickly transform ammonia and nitrites, nitrates become perhaps the most important nutrient supply for your plants.

Depending on your stocking density, light levels, and number of plants, you may have enough nitrate being built up to fully supply your fish. Or you may need to add more. Generally speaking, when adding nitrates to a planted tank, most aquascapers will use potassium nitrate (KNO3), which can be purchased from chemical supply companies in a powdered salt form.

Phosphorus

Phosphorus has a love-hate relationship in aquariums. It's absolutely vital for the health of both plants and fish. However, it often ends up being present in excessive amounts, which is said to be a factor in algae problems. Phosphorus sometimes enters the aquarium through the water supply, but it can also be introduced (in sometimes significant amounts) via fish food. Because phosphorus is a necessary element for the fish, it is added to virtually all fish food. The fish eat it, absorb and use some of the phosphorus, then pass on the rest.

Some fertilizers will have minimal (or even no) phosphorus present because of the potential for leading to algae problems. However, in order to have a successful planted tank, you need to ensure that there is enough for the plants to use. For most keepers who are going to add phosphorus, they're going to do so in the form of phosphates, specifically monopotassium phosphate (KH2PO4).

Potassium

Potassium is a nutrient that can easily be overlooked, but is also one of the easiest to deal with. When not balanced with nitrogen and phosphorus, potassium can easily become the limiting factor that grinds plant growth to a halt. However, potassium is also the nutrient that is least likely to cause problems if there is more than needed. It's not particularly harmful for fish, nor is it likely to fuel excess algae growth.

There will be a certain amount of potassium added when dosing both nitrogen (via potassium nitrate) and phosphorus (via monopotassium phosphate). For dosing additional potassium, most commonly used is potassium sulfate (K2SO4).

Additional Nutrients

In addition to the three major nutrients, there are a number of additional nutrients, often referred to as micro nutrients or trace elements. These include such elements as iron, magnesium, manganese, zinc, and others.

Most of the time when micro nutrients are added it's through a fertilizer mix that contains many or all of the necessary nutrients. Rarely will aquatic plant keepers dose the specific micro nutrients individually.

Adding Fertilizers

There are two main ways that plants take in nutrients: from the substrate and from the water column. While most plants will feed from both sources, certain plants are better at one method than the other. All plants will benefit from dosing fertilizers into the water column, but for the best results, supply nutrients in both ways.

Substrate Feeding

Certain plants, such as swords, *Cryptocoryne spp., Vallisneria spp.,* and bulb plant, show tremendous growth when they are able to absorb nutrients from the substrate. These plants, especially, benefit from substrates that are specifically designed for planted aquariums. For the most part, these substrates are designed to "store" nutrients that can then be passed on to the plant. Additionally, they are made with grain sizes that strike the right balance between being fine enough for small roots to easily be able to grab ahold of and having enough space between the grains to not suffocate the roots.

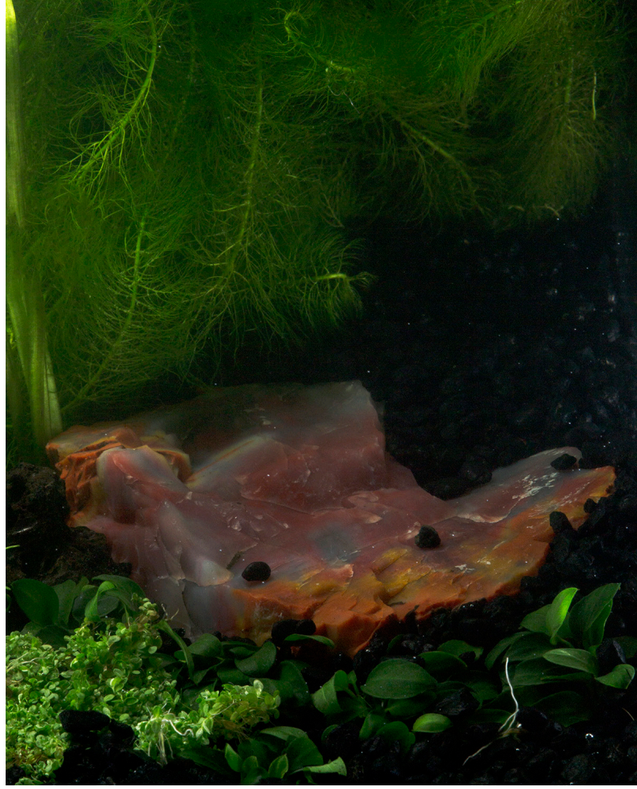
Another great approach to feeding through the substrate is by using root tabs, which are essentially small "pills" of nutrients you bury in the substrate. They will slowly release the nutrients they contain, allowing the plants to feed. Root tabs can be used with any aquarium substrate, allowing some degree of success with inert substrates such as sand that may not be as ideal for plant growth.

Water Column Feeding

Plants such as anacharis (also called elodea), Hygrophila spp., Rotala spp., and Ludwigia spp. will pull most of their nutrition from the water column. There are a number of different fertilization methods that have been developed and are advocated by a number of different people.

The simplest, but least precise, method is to buy commercially available fertilizers and follow the instructions that come printed on them. These may be available either as individual nutrients (plus a combined trace element mix), or you may find them combined into one macro nutrient formula that adds nitrogen, phosphorus, and potassium simultaneously.

Among dedicated planted tank keepers who want the most control over their tanks' results, there are several



plans designed to use powdered salts dosed in a precise schedule to ensure that plants always have enough nutrients to never hit a limiting factor. While almost no retail fish store will sell the supplies to follow one of these plans (requiring you to place bulk orders from chemical supply companies), they do add the benefits of being less expensive in the long run and allowing precise control.

One such method, the Estimative Index (EI) Method, is a plan that involves heavy dosing in order to supply an excess of nutrients. This prevents any nutrient deficiencies from occurring as there is always an abundance of nutrients. However, in order to prevent too many of these nutrients from building up, you must perform at least a 50% water change each week.

Another popular method, PPS-Pro (Perpetual Preservation System), involves diluting the nutrients in water in order to dose smaller amounts every day. The goal for this method is to supply only as many nutrients as the plants will use that day. When done correctly, there is no need to worry about the buildup of excess nutrients. There are a number of additional dosing plans. No single plan is perfect, and they all have their own strengths and weaknesses. When deciding which plan to follow, the best thing to do is to research them individually and decide what plan best works for you.

Plant Nutrient Deficiencies

Healthy

Green leaves, nice shiny sheen.

Nitrogen

Older leaves on the plants start to turn yellow

Phosphorus

Similar to nitrogen, older leaves begin to turn yellow and will often start to fall off. There may be small dead areas on leaves.

Potassium

The plant starts to turn yellow and small brown spots start forming on older leaves. Young leaves start to have yellowing on their edges.

Iron

New leaves are pale in color, though older leaves are less affected. The leaves can become almost transparent if the deficiency is bad enough.

Magnesium

Like iron, leaves turn pale, though it happens with both old and new leaves. The veins of the leaves, though, will remain green, unlike in other deficiencies.

Nutritional Deficiencies

With how important these nutrients are, it stands to reason that there will be problems when the amount of one nutrient is too low. And this is true. Whenever any nutrient is lacking the growth of the plants slows down or stops and the plants' health deteriorates. It is also likely for algae to begin to emerge and take over.

One of the most readily noticeable problems, which has a number of variations and can be somewhat difficult to diagnose precisely, is that the leaves and plants begin to turn from green to yellow. This is often the first sign of a problem, as the normally green leaves fade to yellow before dying and turning brown. Other common problems include spots or holes forming in leaves and the leaves being deformed.

Love Is In The Air

Plants, like animals, need to "breathe". They do so in different ways, and generally speaking their "breathing" is the reverse of ours. While we breathe in the atmosphere, use the available oxygen, and exhale carbon dioxide, during photosynthesis plants take in atmosphere, use carbon dioxide, and release oxygen.

In a planted tank, the fish and plants are creating opposing forces on the gases dissolved in the water. Except in extreme cases, the fish in your tank are not going to consume all of the oxygen, so you don't generally have to worry about supplying more for them. Likewise in a low light tank, where you're not adding extra nutrients for the plants, the plants are probably not taking in carbon dioxide fast enough to deplete it.

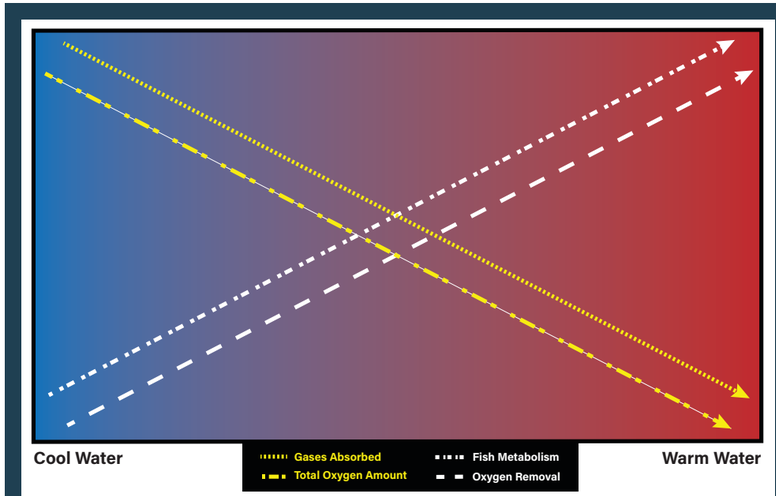
In medium and high light tanks, though, when plant growth is accelerated, the carbon dioxide is likely to run out fairly quickly, even with the fish releasing more. If you're going to be running high lights and adding fertilizers, you need to supply extra carbon dioxide to make up for that.

Adding CO_2

Supplementing the carbon dioxide in your aquarium is one of the new concepts that planted tank keepers need to learn before they can be truly successful. There are a few different methods that taken with various degrees of success.

Liquid Supplementation

There are several products on the market that claim to act as a source of carbon for plants, eliminating the need for any other form of carbon dioxide supplementation. While these can have their uses and certain benefits, when it comes to maximizing plant growth they generally don't work very well. Some also run the risk of poisoning fish if accidentally overdosed. You can research these products to see if any of the secondary benefits are worth using them, but don't expect them to replace a true carbon dioxide supplement.

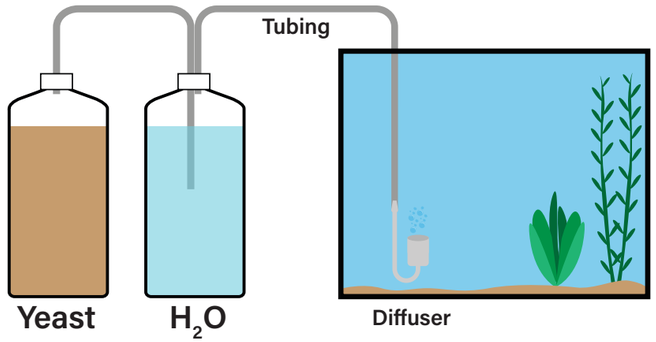


Warmer water reduces the amount of gas that can be absorbed into the water, as shown by the yellow lines. It also speeds up the metabolism of the fish living in it, as shown by the white lines. As a result, your fish are removing more oxygen from a tank that has less total oxygen available, putting them at a higher risk of depleting their oxygen supply. For warmer tanks, particularly heavily stocked ones, try to choose tank dimensions that maximize their surface area and think about adding an air pump to speed up the replacement of lost gases.

DIY systems

Many centuries ago, man discovered that certain forms of yeast will "eat" the sugar in a liquid and change it into alcohol, and thus beer, mead, wine, and countless other intoxicating beverages were created. One side effect of this process is that the yeast also releases carbon dioxide.

Somewhere along the way, enterprising aquarists who wanted to save some money decided to harness this power to create a source of carbon dioxide for their plants. And it worked! For a while. The typical DIY system is created by using a few sturdy bottles, water, sugar, yeast, air tubing, and an air diffuser to get carbon dioxide into the aquarium.



To set up a yeast-powered DIY system, mix up a batch of sugar water into a large bottle and add yeast. Run an air tube from the lid of the bottle into another bottle of water, with the end of the tubing under the water (this acts as a filter to prevent accidentally dosing your aquarium with alcohol). Run a second air tube from the second bottle, into the aquarium, and use an air diffuser (e.g. an air stone) to break the gas bubbles into small pieces.

This system works, but it's not without problems. As the sugar is turned to alcohol, eventually the yeast die from alcohol poisoning. Bread yeast, while the easiest to find, has the lowest tolerance, while beer, wine, and champagne yeasts can survive progressively higher alcohol levels, and thus last for longer before needing to be replaced. Generally speaking, a DIY system will put out a decent supply of carbon dioxide for two to four weeks before needing to be remade.

With a DIY system, there is no way to control the amount or timing of the carbon dioxide going to your tank. What the yeast produces is what you get, and it won't be a stable, steady amount over the life of the setup, which can lead to problems with your plants. It can also be difficult to ensure air tight connections where you put the tubes into the bottles.

Mini Pressurized Setups

As planted tanks grow more popular, more aquarium supply manufacturers are making small systems designed to be more of a "plug and play" system, providing more control and stability over the DIY setups. You can find these

sorts of setups based off of both compressed air cartridges as well as more manual pressurized spray bottles.

Many of the cartridge systems will have some sort of a control mechanism, such as a valve you can turn to release more or less air at a time. The air would then go through an air tube and through some sort of diffuser. Because plants only consume carbon dioxide while going through photosynthesis (i.e. when there is light), you can close the valve at night to conserve the air.

Alternatively, some systems come in a bottle similar to an aerosol spray bottle. This connects through an air tube to some sort of holding mechanism where the air "pools", slowly dissolving into the water. When the bubble of carbon dioxide is mostly dissolved, you just spray more into it.

These systems can be relatively effective for small aquariums. You have much more control over them than you do with a DIY system, but there is a significant amount of manual control required. If you're going to be away from your aquarium for a few days, you may run into problems maintaining appropriate carbon dioxide levels. You also don't have the ability to completely fine tune your supplementing. Plus, replacing the CO_2 cartridges can become expensive over time.

Full Pressurized Setups

The gold standard for supplementing carbon dioxide in planted tanks starts off with a full sized CO_2 tank. These are available from resources such as welding and home brew supply stores and come in a range of sizes. Depending on the size of your tank, you may look for five, ten, or twenty pound canisters.

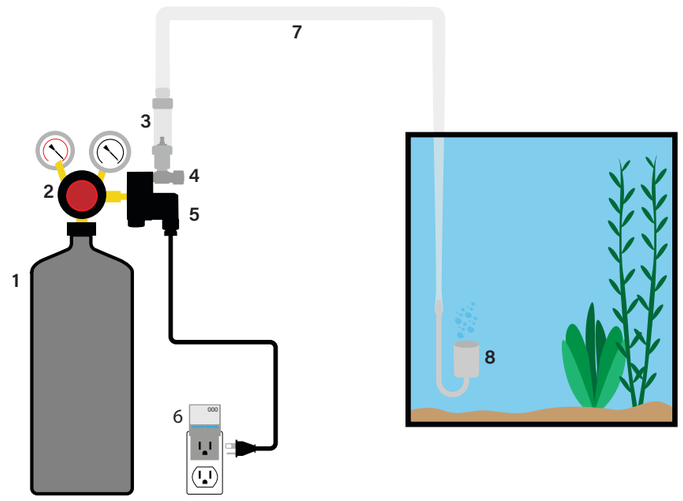
To go with the CO_2 tank, you will need a regulator, which reduces the pressure of the gas coming from the tank. These come in either single stage, which works in one step, or dual stage, which uses two steps to reduce this pressure. Because of their added complexity, dual stage regulators are considerably more expensive. However, they are also significantly safer for the overall health of your tank.

Some single stage regulators, especially on the cheaper end, have a tendency to fail when the pressure inside of the tank drops below a certain point. When this happens, they have been known to "dump" the rest of the gas all at once. Unfortunately, this causes the carbon dioxide level in the aquarium to climb to the point of suffocating your fish. While this is not a guaranteed result of a single stage regulators, many will recommend going dual stage just to be safe.

Most people will connect a solenoid to their regulator. Basically, a solenoid is an electronic valve that stays closed until it is powered. You can plug the solenoid in through a basic electric timer to have the air turn on and off on an automated schedule, which allows you to stop adding carbon dioxide at night when the plants are not using it.

Whether or not you use a solenoid, you will need a needle valve to fine tune how much gas flow you have. There's a wide range of quality (and prices) of needle valves. You should try to avoid lower quality ones that are hard to precisely dial in. To measure how much air is coming through, you can use a bubble counter. Essentially, a bubble counter will connect either directly to the needle valve or along the air line and pass the gas through a portion of liquid. You can dial in the needle valve and count how many bubbles are getting passed through every second to precisely control how much carbon dioxide you are adding to your tank. A general rule of thumb is to start with one to two bubbles per second and adjust from there as needed.

Finally, the carbon dioxide will go through the air tube to a diffuser. There are several different styles and materials of diffusers you can choose, including standard air stones (generally not the best choice), dedicated diffusers, and various devices that try to hold the carbon dioxide in the water for longer to try to give it more chance to dissolve into the water. The diffuser you choose will dictate what pressure your regulator should be set to. Generally speaking, the better diffusers will have smaller pores and make smaller bubbles, which creates more surface area and allows more carbon dioxide to diffuse into the water.



1. CO_2 Canister
2. Regulator
3. Bubble Counter
4. Needle Valve
5. Solenoid
6. Electric Timer
7. Tubing
8. Diffuser

The Pro and Cons of CO_2

Carbon dioxide is one of the three vital components to success in keeping a planted tank. There is no way to be successful if you do not balance it with the available light and nutrients. That doesn't mean that every planted tank must have CO_2 supplementation, but many tanks will. Many problems that you may encounter, including algae breakouts and an overall lack of growth, can be completely fixed by adding carbon dioxide.

However, there are also difficulties and risks involved when using carbon dioxide. It can take a different set of knowledge and understanding in order to successfully set up the entire system. It certainly adds a fair amount of cost to set up decent quality pressurized CO_2 system. And if you don't have it set correctly, you do run the risk of suffocating your fish. But the potential benefits of carbon dioxide make overcoming these challenges well worth the effort

Avoiding Algae

Algae is a nuisance that virtually every aquarium keeper will have to battle at some point. It is estimated that there is anywhere from 30,000 to over a million species of algae. Fortunately, the number of algae strains commonly seen in aquaria is fairly low, and few if any are actually harmful for the fish. Certain fish love to eat certain types of algae, so in some cases a small amount of algae can be beneficial. But in most cases we want to get rid of algae in order to not detract from the overall beauty of our tanks.

What is algae? There is some disagreement over what algae truly is, and there are some organisms that we refer to as algae that are very different from any true definition of algae. Depending on who you ask, algae may be considered a plant or a protist. Blue-green algae, the slimy film algae that can quickly cover all surfaces of an aquarium, are actually a type of bacteria called Cyanobacteria.

Whatever the type, and however they're classified, plants and algae do share a number of characteristics in common. They both use the available light, nutrients, and CO_2 to grow, but their ideal levels are different. Because their needs are so similar, it is easy to accelerate algae growth when you're trying to grow plants.

Algae Outbreaks

Even though algae are rarely harmful to a tank, you can easily draw parallels between algae in an aquarium and bacteria in a human body.

Every aquarium has a diverse range of algae present at virtually all times, much like people are hosts to a wide range of bacteria at any given time. However, as with people, if an aquarium is well maintained and taken care of, the natural processes of the aquarium will keep the algae in check and it will be unnoticeable. There are even certain types of algae that play beneficial roles in aquaria just as there are beneficial bacteria that play invaluable roles in your body.

However, when this balance is interrupted, an outbreak can easily occur. The systems get thrown off and the algae that was being kept in check begins to flourish, taking over and starts wreaking havoc. Fortunately, once you know what conditions are ideal for algae, you have a pretty good idea of how to avoid letting it get out of hand.

Do you want algae? Because that's how you get algae.

Most of the time when there are significant algae problems in a planted tank, it's due to having more light or nutrients than your CO_2 levels can support. If you're not dosing CO_2, or if you're using a DIY system, it's very easy to end up in a situation where the plants are not able to take full advantage of the light and nutrients present. This gives algae an ideal environment to take over.

Adding CO_2 supplementation (or improving the CO_2 system being used) allows plants grow to their full potential, utilize even more of the spare nutrients in the water column, and creates conditions where the plants can easily out compete algae.

If you are running a low light tank without CO_2 supplements, check that your light isn't too bright and your tank isn't getting direct sunlight from a window. You can also try reducing the length of time that your light is on during the day.

Finally, reduce the amount of nutrients that are present. Don't feed your fish as heavily, remove some fish from your tank to reduce the amount of nutrients they're putting into the water (maybe a good excuse to buy a new aquarium?). Increase the frequency of your water changes in order to physically remove nutrients. If you think that excess nutrients are still a problem, you can also try adding additional plants to your tank, particularly bunch plants that will pull a lot of nutrients from the water column.

Plant Safe Algae Eaters

It's always better to eliminate the source of algae rather than try to control it after the fact. But if you're looking for some ways to reduce algae that's in your tank, there are many animals that will happily eat it. The trick is choosing the ones that won't damage your plants

Snails

Arguably one of the best animals for eating algae in many tanks are snails. There are certainly snails that have a well-deserved reputation for multiplying endlessly and becoming a major nuisance, but there are also species that are much more manageable.

A great option for planted tanks are freshwater nerite snails. These snails are ravenous for algae, and can be very efficient at removing many of the common types of algae. Additionally, they stay small and can be kept with aquarium plants without destroying your aquascaping. Best of all, while they live in freshwater, their eggs can only hatch in saltwater, meaning that you don't have to worry about unwanted population growth.

Shrimp

Among planted tank enthusiasts, particularly those who keep small tanks, certain shrimp are renowned for taking care of spare algae without harming their plants. Best known for this are the Amano Shrimp, but most shrimp varieties will likely eat at least a little bit of algae. Plus, shrimp have a certain amount of charm it's almost impossible not to fall in love with.

Otocinclus

If you have a tank with small, peaceful fish, otocinclus are potentially one of the best algae eaters you can choose, though they're not without challenges themselves. They stay very small, barely getting over an inch in length, which makes them incompatible with many more aggressive fish. They also have the reputation of being somewhat sensitive and fragile, so you want to ensure you have a well established aquarium with stable water parameters. But if you can provide a suitable aquarium, a school of otos is a great choice.

Flying Fox

True flying foxes are another great choice, though there are some extremely similar (and less effective) species

that can create difficulty in finding the correct fish. However, once you find some flying foxes, they do a great job of eating many different types of algae, including black beard algae that many other algae eaters won't touch. They are normally quite peaceful and hardy, typically growing to around 5 inches.

As a note, one fish that is widely available and sometimes gets confused with flying foxes (even though they are fairly different and easy to distinguish) are Chinese algae eaters. While these do a decent job when they're young, as they grow they become increasingly carnivorous and aggressive, making them a bad choice for most tanks.

Plecostomus

Plecos are the first fish that many people think of when they hear the words algae eater, but you need to be careful when choosing what pleco to add. Most are omnivorous, with a fair bit of variation between species in how much algae they'll actually eat. If you are going to add plecos that eat more plant matter, there is a balance that you need to find to ensure they don't start supplementing their food with your plants. You may need to supply them with algae wafers or fresh vegetables if your tank gets too low on algae for them.

One of the better plecos to get for algae control is the bristlenose pleco. They stay small enough (around 6 inches) to be manageable in most aquariums and algae is a much larger proportion of their diet than it is for common plecos. They also tend to fairly safe with aquarium plants, making them good choices for planted tanks.

Setting Up A Planted Tank

Armed with the knowledge of what plants need in order to thrive, it's time to start planning out and putting together a planted tank. You can take this information and start experimenting, or you can take a little more time to figure out the approach you want to take.

What Kind of Aquascape?

As with putting together most things, you need to figure out what direction you want to go in order to know what pieces you need. You wouldn't try to build a bicycle out of parts for a computer desk. There are several general styles of planted tanks that most aquariums fall into.

Biotopes

Biotope aquariums, while requiring more research than many others, can be fascinating and enormously satisfying. To create a biotope aquarium, you use only the plants and animals found in a specific region and then layout the tank to recreate what it would look like if you were actually to go diving there. Often, this will result in fewer plants than in other planted tank styles as many areas don't have extremely dense plant growth. Instead, the plants will often be interspersed among driftwood or rocks.

Popular biotopes include the Amazon River or its tributaries (e.g. Rio Negro, Rio Xingu) and Southeast Asian biotopes. For more information on biotopes, see Chapter 6.

Jungle Style

Tanks that could be considered jungle style run a range from carefully arranged and maintained to toss and forget. The common theme among them, though, is that they are jam packed with large plants in a fairly "unkempt" manner. Ideally, the aquascaper would aim for a "controlled chaos" in their tank, but it can be hard to see the order in many jungle tanks. While there is very little open area in jungle tanks, they are frequently stocked relatively densely with larger fish.

Because the large, dense plants will often shade the bottom of the tank from getting as much light, jungle tanks can be a great setup for shy fish that like darker environments. For example, certain catfish and knifefish can thrive in jungle style aquariums.

Nature Aquarium (aka Amano Style)

The late Japanese aquascaper Takashi Amano created, refined, and popularized the nature aquarium style of aquascaping. They have become extremely popular due to their artistic and aesthetically pleasing style, which aims to recreate a natural environment in a scaled down aquarium. Many nature aquariums features hills, mountains, and trees, all carefully arranged to appear as though they weren't underwater at all.

Creating a nature aquarium requires precise planning and a keen attention to detail in order to bring the final vision to life. There is no leaving anything to chance. Often with these aquariums, the fish chosen are secondary to the aquascape, chosen to enhance the overall scene and not take away any of the focus.

Iwagumi Aquascapes

If nature aquariums are an artistic recreation of nature, Iwagumi aquascapes are the minimalist art of planted tanks. Iwagumi aquascapes are largely left open, with carefully selected rockwork forming the primary focus.

These stone formations are often highly angular, jutting out of the substrate. The plants in these aquariums are typically limited to only one or two species that form short dense carpets.

As with nature aquariums, the fish are generally chosen to not compete visually with the overall effect of the aquascape.

Dutch Style

The Dutch Aquarium style is perhaps the oldest aquascaping method, first becoming popular in the 1930's. As opposed to the more abstract styles of nature and Iwagumi aquariums, this style seeks to recreate methods one might see in a terrestrial garden, where the plants themselves are the main focus of the tank. The design of the aquascape relies on carefully arranging variations of size, texture, and color in the plants.

In order to maximize the effect of these variations, attention has to be paid to concepts such as the rule of thirds, where important focal points are placed at the visual thirds instead of symmetrically in the middle, and "terracing", where smaller plants are placed towards the front to create a sense of depth.

Choosing Plants

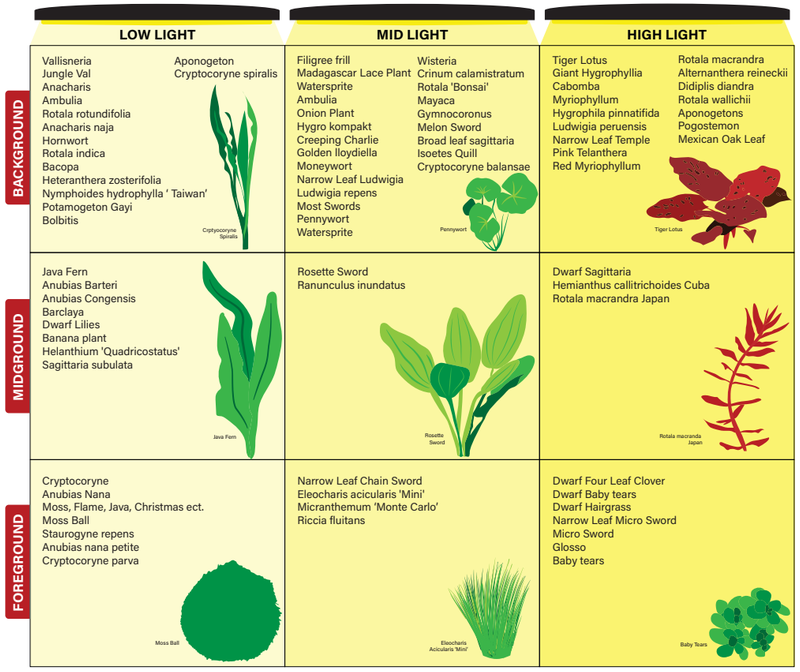
The plants you choose are going to be determined by a combination of factors including the style you're going for, the size of your tank, what equipment you're going to use, how much maintenance you want to do, and your personal preferences.

An important consideration is how much light a specific plant is going to need. If you're going to use a low light setup, some plants simply are not going to be able to grow. If you're wanting to grow plants that develop deep red leaves, you are going to have to use very bright lights, which also requires fertilization and carbon dioxide supplementation. Additionally, most high light setups are going to result is significantly more plant growth, which in turn leads to needing to perform more maintenance such as trimming, pruning, and potentially replanting.

Plant Sizes

In planning out your tank, you need to consider how large the plants are going to grow. Many sword plants will grow to be more than twelve inches tall and almost as wide. In a small aquarium, a single Amazon Sword plant may fill up all of your available space. Some Vallisneria species can grow to be almost three feet tall. Plants such as Dwarf Baby Tears stay shorter than an inch but can, under the right conditions, create a solid carpet along your substrate.

Placement and Light Chart



Low Light Plants

For a low light setup with no additional fertilization or carbon dioxide, good plant options include:

- Cryptocorynes (wendtii, spiralis, parva, etc)
- Anubias
- Banana Plants
- Most mosses (Java, Flame, Christmas, moss ball, etc)
- Anacharis
- Vallisneria (Jungle, Corkscrew, etc)

Medium Light Plants

If you're going to choose slightly brighter lights and use some fertilization and carbon dioxide, some options include:

- Madagascar Lace
- Ambulia
- Hygrophila
- Ludwigia
- Most Swords
- Rotala 'Bonsai'

High Light Plants

With high light levels and all of the additional considerations, virtually any plant can be grown. Even low light plants will thrive. Some plants that can't grow in lower light levels include:

- Most Aponogetons
- Didiplis diandra
- Myriophyllum
- Pink Telanthera
- Rotala macrandra
- Hemianthus callitrichoides (aka Dwarf Baby Tears)

Choosing Hardscape

When people talk about the hardscape of their aquarium, they are referring to any rock or wood that is integrated into the overall design. In some aquascapes, such as Dutch Style, hardscapes are often completely eliminated, with the structure of the layout coming from the plants' overall sizes and how you prune them. In some aquascapes, including all Iwagumi and some nature tank designs, the hardscape is absolutely integral to the success of the overall design. In biotopes, the hardscape is often chosen to mimic tree roots, fallen branches, or the rocks present in the natural ecosystems. With some of the more freeform layouts, the use of hardscape is left entirely to your own preference.

Driftwood

Driftwood will, for a period of time, leach molecules called tannins into the water. These tannins serve a variety of purposes in trees, including protecting them from certain pests and diseases. When wood containing high numbers of tannins soak in water, they are released, turning the water somewhat brown, resembling tea. Some aquarists find this brown water unappealing, while others quite like it. A number of rivers, particularly in the Americas, have high levels of tannins present and are called blackwater rivers as a result. If you are wanting to create a Rio Negro biotope (Rio Negro literally translates into Black River), you likely will want to supply sources of tannins.

Aside from the visual difference, there are a few other effects of the tannins released by driftwood. The same molecules that help protect trees from disease can also have mild antibiotic or antifungal properties in your aquarium. While this is not going to be enough to treat a major disease breakout, it could help bolster the overall health of the tank, helping prevent minor infections from gaining strength. Tannins will also help make the water softer and more acidic. There may not be a significant change if your water is fairly hard, but if you already have soft water, it can cause the pH to drop a decent amount. Some natural rivers' pH can drop well below 4.0 because of this.

If you want to add driftwood to your aquarium but don't want to have the other side effects, there are a few ways to lessen or eliminate them. Using a strong carbon filter can pull a lot of the tannins out of the water, though you will likely need to replace the activated carbon fairly regularly as it "fills up" on tannins. Soaking driftwood before putting it into your aquarium can pull the tannins out, but you will need to regularly change the water it's soaking in and this method could take a significant amount of time before the wood stops releasing them. If your driftwood is small enough, or you have a large enough pot, you can also boil the wood to speed up the process, though again you need to regularly change the water and pay careful attention to not boil all of the water out of the pot and catch anything on fire. There are also certain products available that are designed to specifically remove tannins from the water.

Rocks

There is an enormous variety of rocks out there, and they all have somewhat different properties. For determining whether or not they're good choices in an aquarium, the most important characteristic to be concerned about is whether or not the rock will react with or dissolve in the water.

A number of different rocks will slowly dissolve, releasing various carbonates into the water. Depending on your goals, this may be a good or bad thing. Limestone (including Texas Holey Rock), aragonite, and petrified corals (not really a rock, but close enough for this discussion) are commonly used for exactly this reason. They are great choices for adding hardness to water and buffering the pH higher.

Some rocks may contain traces of heavy metals that can prove to be toxic to fish and invertebrates. Sandstone, amethyst, and pyrite can all potentially leach harmful substances into your water.

The most commonly used rocks that have little or no chance to alter your water chemistry are slate, granite, some forms of quartz, and lava rock.

Planning A Layout

Once you have all of the pieces ready to go, you need to think about how you want them arranged in the aquarium.

The Rule of Thirds

A common concept in art and photography is the Rule of Thirds. Basically, it states that if you take your canvas (in this case the aquarium) and separate it into thirds, the most visually pleasing focus points will fall on or near those divisions. In an aquarium, we have three different dimensions we can split into thirds: left to right, top to bottom, and front to back.

To utilize the rule of thirds in planning out your layout, think about how to position certain elements to best utilize those thirds. For example, if you are going to be doing a few different height plants, try to place the small foreground plants in the front third, midground plants in the middle third, and background plants in the back third. If you're using a large piece of driftwood or rock, position it on either the left or right third line. If you're adding one plant that has red leaves and grows fairly large, you can position it around the back left or back right intersection with it emerging from behind shorter plants around the top third line.

Account For Size

Odds are, the plants that you buy are going to be very small, but if you have taken the time and effort to learn how to care for that plant, there's nothing to stop it from growing to it's full potential size. When you're planning your overall tank layout, make sure to think about about what it's going to look like when fully grown and give it enough room to reach its full size. That may mean that for the first few months your tank looks more bare than you want, but have patience and trust that the plants will fill in those gaps.

Variety is the Spice of Life

No matter how amazing you think a certain plant is, if that is the only thing in your tank, it's not going to have the visual impact you probably want. Think about ways to add variety and play certain plant characteristics off of each other.

The most obvious source of variety is in plant size. Combining smaller and larger plants in the right way can create a powerful sense of depth to the layout. Generally speaking, you will want to keep smaller plants towards the front (so that you can see them) and larger plants to the back, but you can mix it up, especially if you plan wisely and prune the plants in a way that creates a smooth transition in sizes.

You can also add variety by mixing plants that have different leaf sizes and shapes. For example, cabomba and hornwort both have very fine leaves in fan shaped patterns while anacharis and rotala both have small round leaves that go up the stalk of the plant. Swords and Cryptocorynes have long leaves that emerge from their base.

Color is another source of variety, though it can be more difficult to achieve. Most aquatic plants will be various shades of green, while some plants, such as certain Cryptocorynes, may be a darker bronze color. There are a number of very popular plants that can grow brilliant red leaves, though to achieve this almost always requires very high levels of light and an abundance of nutrients and carbon dioxide.

Putting It All Together

When you've learned what plants need to survive, figured out what kind of setup you want to create, decided on the plants and hardscape, and have an idea of how you want to lay it all out, then it's time to start putting your tank together.

Add the Substrate and Hardscape

The first thing you want to do is add the substrate to your tank. You want a thick enough layer to allow plenty of room for the plants' roots to be able to hold on to. Many aquascapers will also gradually slope the substrate so that the thickest layer is at the back, which allows a nicer visual appearance while slightly elevating plants that are farther back above ones in front of them. This is also the best time to add any rocks or driftwood you're going to use in your tank.

Add a Small Amount of Water

The easiest time to place your plants into the substrate is to do it while there is just a little bit of water in the tank. This essentially allows the roots, substrate, and water to interact as they normally would, settling in the water as opposed to the air. It reduces the chance of plants unrooting when adding water while also eliminating the difficulty of having to work underwater.

Plant the Plants

Next you'll need to do the actual planting. If your plants come potted, you'll want to remove them from their pots, try to get rid of as much of the rock wool they are potted in as possible, and give them a good rinsing. If you're using tissue cultured plants, you'll want to rinse off the agar (gel) or liquid medium they came in. No matter what source you are using, you want to end up with just the plants and their roots.

Many aquarium plants come with multiple plants "bundled" together. You can separate these plants in order to better spread them out, letting you get the most coverage out of each pot or package. Depending on the plant, the way they're packaged, and the amount of time and effort you're willing to take, you may get a few individual plants or you may be able to separate them into ten, twenty, or more pieces.

With your plants prepared, you want to carefully bury their roots under the substrate. Using tools such as planted tank tweezers or forceps (which are generally long handled) can help make putting them exactly where you want easier. For larger plants, you want to ensure you leave plenty of room for them to grow and spread. For carpeting plants, you want to place the separated pieces fairly close to each other (around half an inch apart). This will help strike the balance between maximizing the speed at which they will fully carpet your substrate while also allowing you to use fewer total plants (saving money and effort).

Fill Up the Tank

With your plants and hardscape all ready to go, you're ready to finish filling up your aquarium. Be very careful when adding water. It's very easy to accidentally uproot some of your carefully placed plants by pouring in the water too quickly. A slow, gentle stream of water, preferably onto an area with no plants, is ideal. You can try to direct the water onto your hardscape in a further attempt to not disturb your plant.

Finishing Up

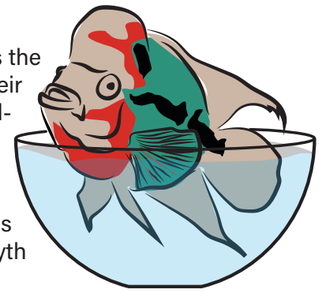
With your tank filled, you just need to finish setting up as you would with any other aquarium. Make sure your equipment (lights, filters, heater, CO_2 system) is set up and working properly. Start your fertilization routine (if you're using one), start cycling your tank, and start enjoying your new tank.

10 MYTHS AND MISTAKES

With the advent of the internet, there is an almost limitless amount of information and advice that you can draw from in order to guide our fishkeeping efforts. But it hasn't always been this way. While there have been books and scientific research on aquariums going back many years, most people would learn about fish keeping by a combination of trial and error and word of mouth. This has resulted in a number of myths and common mistakes arising that have persisted despite our new information resources. Many of these contain a grain of truth but are missing the complete picture. Some are the result of misguided good intentions. But understanding why these are problems can help you become a better aquarist.

Myths

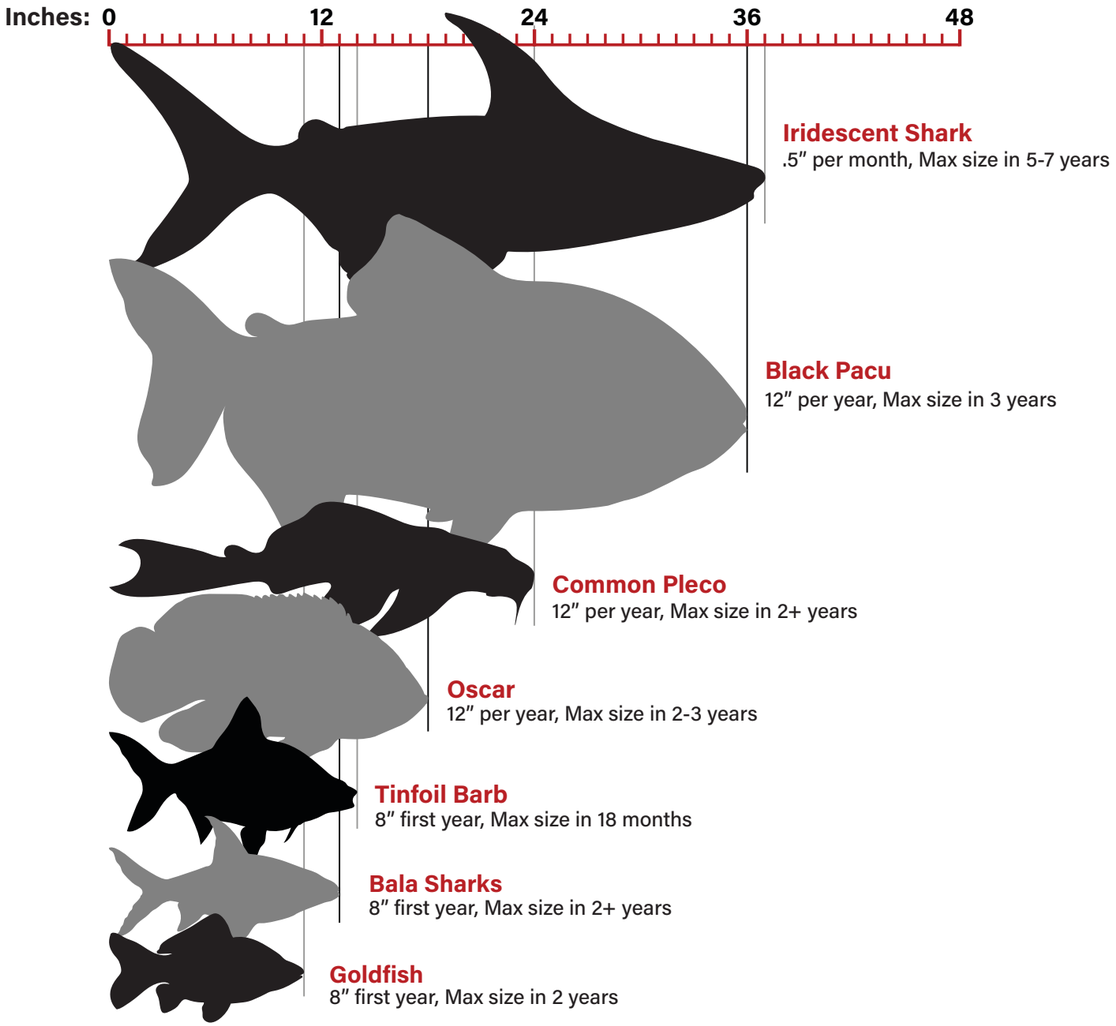
"Fish only grow to the size of their environment"



If there's one myth that outshines them all, it's the myth that fish will only grow to the size of their container. This myth is so pervasive that almost every person, whether they've ever had an interest in keeping fish or not, has heard it. It's one of the most often debated topics in fish keeping that continually gets revived as new fish keepers join the hobby with this myth already firmly planted in their head.

Like all good myths, there's an element of truth that keeps this misconception thriving. There are many people who get their first fish, a goldfish, perhaps won at the fair, who then put it in a bowl where it lives a year or two and then dies. The fledgling aquarist, not knowing any better, thinks that they have been a good fish owner, having given their goldfish a "long life" (hey, it lasted more

Growth Chart



These sizes and growth rates are based on optimal conditions for each fish.

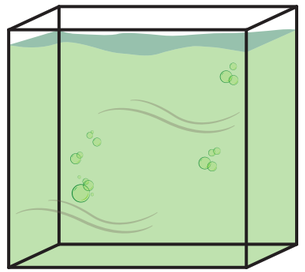
than a week or two, which is when all the stereotypes say goldfish should die) and it never outgrew its bowl. The unknowledgeable fish keeper (who has seen pictures of giant goldfish) deduces that since their goldfish lived a long time and never grew so large it couldn't fit in its bowl that the old stories of fish growing to the size of their containers must be true.

Unfortunately, the fish keeper is wrong. Fish will continue to grow even when the environment is too small. Why didn't the goldfish end up outgrowing its bowl? There are a few reasons why.

The most basic reason is that despite living for a couple of years, that goldfish was very young. When given proper care, a goldfish can live for thirty years or more. The Guinness Record for oldest goldfish is over 40 years. That goldfish, at two years old, still had the potential for many more years of life.

Goldfish, along with several other species, are extraordinarily hardy fish. They can live in deplorable water conditions and survive on foods that contain minimal nutrition. But that doesn't mean that these fish are healthy. Eventually, these bad conditions catch up with them. When kept in a bowl, particularly one that doesn't have its water changed often, toxic organic chemicals and stress hormones build up in the water. Over time, these can cause stunting and deformations on the fish. A stunted fish may indeed stay smaller than a normal one, but that doesn't mean that it's healthy.

As anybody who has worked in a retail fish store that accepts fish brought in by customers, it's not uncommon to see goldfish or plecos that have grown to 6 or 8 inches (or more) in a small 5-10 gallon tank, reaching a point where the fish can't even turn around in the tank anymore.



"Start small"

Starting small is an almost universal human approach to a new situation. You dip your toe into the pool to get adjusted to the water before diving right in. When you try a new hobby you generally start with the more basic aspects and build your way up as you gain experience and knowledge (and confidence that you're going to want to continue in that hobby).

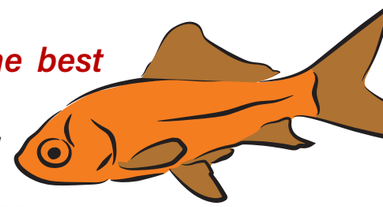
Thus, the inclination to start with a small aquarium makes sense. There's a certain amount of labor involved with aquariums. You have to move them into position, you have to set everything up, you have to clean it and perform water changes. It's logical to try to reduce the amount of labor you're going to to have to do when you're not sure how much you'll enjoy keeping fish.

Unfortunately, small tanks present a lot of problems. A small amount of a harmful substance (such as the ammonia released by your fish) can proportionately create a massive amount of pollution that will have to be physically removed. A little bit of energy gained or lost can result in huge temperature swings, creating stress in your fish that can lead to illness or death. Small volumes of water have small amounts of buffering agents in them, making it harder to protect against pH swings.

A larger tank is going to have more of a built in protection against these problems. They are more stable, resulting in healthier fish. With a large tank, you can probably perform fewer partial water changes, while a smaller tank may require frequent full water changes.

A larger tanks also give you more stocking options. You'll be more satisfied with an aquarium when you're able to keep any fish you want. Smaller aquariums limit what you can have. Angelfish, goldfish, and most cichlids will be far too long for that small 10 gallon aquarium to support.

"Goldfish are the best starter fish"



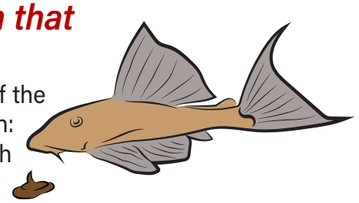
Don't get us wrong, goldfish are great fish. They are arguably one of the most personable fish you can find, learning their owners and begging for food. Their unparalleled hardiness allows them to thrive in less than ideal conditions. They were one of the first fish to be bred solely for the purpose of being kept as pets. But they're not without their challenges.

Goldfish grow large. That half inch fish you win from the fair can eventually end up being more than a foot long. Not only are they long, they also have heavier bodies than many other fish. There are varieties that don't grow as long as the common goldfish, but they almost universally make up for it by being even rounder and more robust. All of this extra body mass means that they produce a lot more waste than most other fish, and with more waste means more cleaning. Goldfish need a lot more water and a lot stronger filtration than other fish their same size.

Goldfish can also be attractive choices because they can be incredibly cheap. Most fish stores will stock "feeder" goldfish (that are intended to be used as food for other fish) that they will sell for well under a dollar each. These can sometimes make for great pets, but they don't come without a degree of risk. For almost their entire life, feeder goldfish are kept in densely populated tanks where there is a greater risk of disease being spread.

If you are willing to commit the time, space, and money to appropriately care for a goldfish, they can be a great fish that is hardy enough to withstand the mistakes that a beginner fish keeper is destined to make. But if you are wanting something with lower care requirements and a shorter natural life span, there are other fish that could be better choices for you.

"I need a fish that eats poop"



Let's get this out of the way to begin with: very few, if any, fish will eat poop. If that is what you're looking for when you walk into a fish store, you need to realign your expectations. Unfortunately, this myth is so prevalent that a number of fish store employees will just point at a fish instead of correcting the customer's mistake.

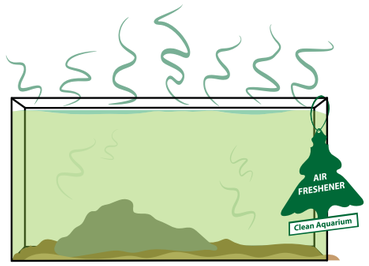
This arises from a very understandable goal, finding a way to simplify cleaning the aquarium. Unfortunately, most people who are looking for a fish to clean their aquarium don't fully understand what it means for an aquarium to be clean. It's not the physical waste but rather the ammonia (and the resultant nitrites and nitrates) that are the problems. But the call of reducing the amount of work an aquarium takes is powerful.

And so fish that can have some benefit at cleaning an aquarium are suggested. But all of these fish have limitations or tradeoffs. Perhaps the most popular suggestion is the common plecostomus. It's true that they can eat a fair amount of algae, giving the impression of cleaning the aquarium, but they grow very large and release a huge amount of waste. This waste will go on to fuel more algae growth. A pleco will ultimately make more of a mess than it will get rid of. Similarly, cory cats and shrimp will pick through the substrate scavenging for uneaten food. This can help, but the nutrients in the aquarium will remain in the aquarium regardless of how many fish they pass through.

That brings us to the crux of the issue. Because an aquarium is a closed system, any nutrients or pollutants that are introduced into the aquarium will stay there until they are manually removed. No fish will get rid of them. You still have to do water changes and siphon the physical waste that settles into the substrate in order to remove them from the aquarium.

"Fish tanks make your home smell"

Many of us have experienced the smell that can be produced by an aquarium. For some people, this smell is enough to discourage them from ever wanting to keep fish. It would be disingenuous to pretend that it doesn't exist.



But an aquarium shouldn't smell. When it does, it's generally the result of an excess amount of decaying organic matter in the water. This could be the result of having fish die and being left in the water to rot or it could be from an extreme amount of overfeeding. In either case, by the time there's a noticeable small it's probably because more ammonia is being produced than the beneficial bacteria colonies can break down.

In addition to creating a smell that is noticeable, at this point the aquarium water is going to be fairly inhospitable for your fish. Any measurable amount of ammonia or nitrite is going to be harmful. You should be performing routine maintenance such as regular water changes (including siphoning detritus from the gravel) and cleaning your filtration in a method that doesn't damage too much of your beneficial bacteria. As long as you are taking care of your fish tank properly, you should never have a noticeable smell.

"Adding plants replaces the need for water changes"

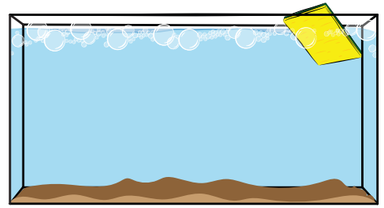
One of the key functions of a water change is to remove the nitrate that builds up from the nitrification process. Live plants will use nitrates as an essential nutrient for their growth. In fact, in a heavily planted aquarium, plants can use so much nitrate that forms of nitrate will be added back to the aquarium in order to prevent a nitrogen deficiency from developing.

Knowing this, it's easy to come to the conclusion that with enough plants you no longer need to perform water changes. But this conclusion is based on an incomplete picture. Nitrate is not the only substance that builds up over time in an aquarium. Phosphates, silicates, and more can cause problems when they accumulate in the water and need to be removed. Additionally, over time buffering agents are used up and the pH of an aquarium can fall.

Water changes remove the harmful substances and replenishes the beneficial ones. There is no substitute for the routine water change.

"The more you clean the aquarium the better"

The opposite of trying to eliminate as much maintenance as possible is being overly obsessive about keeping your aquarium as pristine as possible. This thought process is understandable. We want to give our pets the best care possible. But as with most things, moderation gives the best results. Just as never cleaning your aquarium or performing water changes can cause problems, so can over cleaning it.



In our aquariums, we are trying to foster the growth of a natural (or at least naturalistic) environment. And nature is complex. There are countless biological processes going on in your aquarium at any given time. Not all of the life that is important for you to nurture can be seen. The most well-known organisms that are vital to the overall health of your aquarium are the beneficial bacteria colonies that denitrify your fish's waste.

These beneficial bacteria live on every surface that comes into contact with the water, but they are going to be most concentrated in two areas: your filter media and in the substrate. When somebody decides to perform a deep clean on an aquarium, where are the places they're most likely to concentrate? The filter media and the substrate.

It's not uncommon to hear of a well meaning aquarist who sees the mess that has accumulated in their filter and decides to scrub it as thoroughly as possible and replace all of the "dirty" filter media in order to bring their filter back to "like new" condition. Or perhaps they decide to use a gravel vac to heavily clean their substrate, repeatedly sifting through it until the water they remove is perfectly clear. Even worse is the aquarist that removes their gravel to bleach or completely replace it. In any of these cases, the beneficial bacteria colonies are decimated and the aquarium's ability to detoxify fish waste is destroyed.

If there's one thing above all else that will lead to aquarium success, it's stability. Overcleaning destroys any stability you may have had in your tank. If your tank has been running for a while and you've been following a maintenance routine that involves light cleaning, your aquarium has probably developed some sort of normal baseline. The pH likely stays within a set range, water

hardness probably doesn't stray too far from a set value, and your fish adjust to these conditions. A heavy cleaning can throw a wrench into your aquarium's normal operations. You can cause huge swings in water parameters, resulting in stressed and potentially sick fish.

Heavy cleaning is often done with the best of intentions, but if you're not careful you can create new problems and cause more damage than good.

"You should always/never add salt to your aquarium"

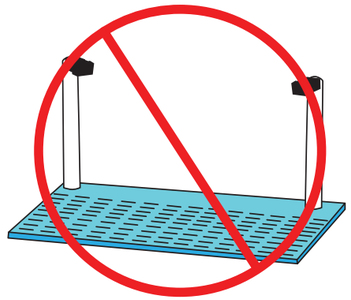
If you're running a brackish or a marine aquarium, you should always make sure the salinity of your aquarium is in the appropriate range. But for freshwater aquarium keepers, whether or not you should add any salt is a hotly debated topic. For every person who says you should add salt to every aquarium you keep you'll find another who argues you should never add salt to a freshwater aquarium. The truth is that they are both wrong.

There are times where you will want to add salt, and times you won't. As an aquarist, your job is to under-

stand the benefits and challenges of salt so that you can decide on a case by case basis whether or not you need to be adding it. What kind of fish are you keeping? What sort of water conditions are present in their natural habitats? Are the fish wild collected or have they been bred in captivity for generations? Am I wanting to use salt to treat for a specific problem or as a routine supplement?

There are some great reasons to use salt. There are also times where using it is absolutely inappropriate. Make sure that you understand the chemistry of an aquarium so that you can choose the best course of action for your aquarium.

"Under gravel filters are bad"

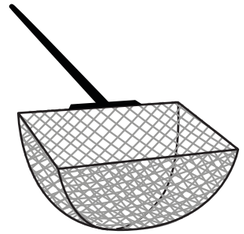


There have been many filtration methods developed over the years. Under gravel, hang on back, canister, sumps, and sponge filters have all had time periods and hobby niches where they have gained popularity and been the filter of choice. All of the popular filtration systems have their advantages and their drawbacks.

Under gravel filters often get a bad rap because they're often seen as old fashioned. For many years, they were the standard filter of choice for almost all aquariums, but people often assume that the newer styles are superior in all aspects. In many ways, newer filters do outperform them. But that doesn't mean there's not a place for the trusty old under gravel filter.

While there's no great way to integrate mechanical filtration, and only limited potential for chemical filtration, with an under gravel filter system, they can be extremely efficient biological filters. They are very simple and there is little risk of them breaking and no longer working. They can be a great alternative to sponge filters in tanks with tiny inhabitants such as breeding pair with fry. Even better, they can be used in conjunction with other filtration methods as a supplement or even a backup in case of emergency.

While under gravel filters may not be the most efficient of all filtration methods, they nevertheless can serve a useful function, and many people have had success for many years with them.



"Collecting fish from the wild is BAD"

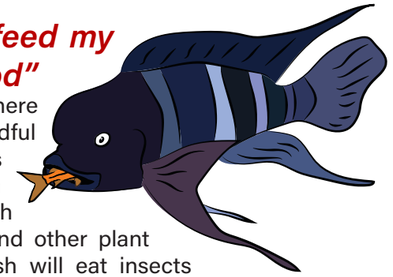
One of the things that we as a hobby should be paying more attention to is the environmental impact of keeping aquariums, and perhaps the most readily apparent area to look at is sourcing fish. There are two general origins for all fish: they were either bred in captivity or they were collected from the wild. Traditional wisdom says that the best way to protect wild populations and habitats is to just leave the fish alone and don't take them from the wild. In reality, though, that's not always the best way to promote conservation.

When done correctly, wild collection can be sustainable. Populations can replenish themselves up to a certain rate, and as long as you are collecting fewer than that number, you can collect indefinitely with no negative effects on the health of the overall population. But that's not the surprising part. The surprising part is how wild collection can actually help preserve entire ecosystems.

A great example of this is Project Piaba and the fisheries of the Rio Negro in Brazil. Project Piaba conducted a great deal of research into the effects that these fisheries have on the Rio Negro, and what they found was that the ornamental fish trade created a powerful incentive for the local communities to protect the Rio Negro. The fisheries are a vital source of income for these communities, and so to keep their livelihood they needed to ensure the populations remained healthy. The biggest threats to the Amazon are logging, mining, and ranching, all of which cause massive devastation. By supporting a thriving fishery, Project Piaba found that you can prevent the local communities from turning to these damaging industries.

It's certainly possible for wild collection to be a negative force if it uses damaging techniques and leads to over fishing. In some parts of the hobby, we need to be actively encouraging captive breeding. Marine fish still overwhelmingly come from wild sources, and while there are organizations and companies diligently working to figure out breeding methods, there is still a lot of work to do. We should definitely be supporting these efforts. Because of captive breeding efforts, so common aquarium fish still exist despite being endangered or extinct in the wild. But there is a place for sustainable collection, and we should be supporting those who use it as a tool to protect natural habitats.

"I have to feed my fish live food"



In the wild, there are only a handful of food options available for fish to eat. Some fish will eat algae and other plant matter, some fish will eat insects (and their larvae), some fish will eat other fish, and some will eat a combination of these. There are a handful of fish that will eat something different, but not enough to really worry about.
It's a natural inclination to want to feed your fish what it naturally eats in the wild, and you should pretty much always use their natural diet as a starting guide to determine what sorts of food to give them. But, unless you are putting forth a massive amount of time and effort, it's almost impossible to perfectly recreate a fish's wild diet.

A lot people who keep large aggressive fish think that they have to give it live feeder fish. And this desire is reinforced because their fish will rapidly and eagerly consume these feeders. But you face some problems doing this. Often, feeder fish are not kept in the best conditions. In order to provide them as an affordable food option, they are almost always kept densely stocked for their entire lives, which increases the risk of them carrying a disease that could be transmitted to your fish.

The second problem is that they are not as well rounded nutritionally as you want them to be. In nature, the nutritional profile of an animal is the culmination of the entire food chain leading up to it. This starts with the algae and phytoplankton that are the beginning of the chain and continues through the insect larvae that eats the phytoplankton and onto the larger fish that eat the insects. Captive bred feeder fish are provided only certain types of commercially available foods that may or may not have an ideal nutritional profile. Feeder fish can lead to a wide variety of nutritional deficiencies for your fish.

There are a lot of commercially available food options out there. Whether your fish is a herbivore, insectivore, piscivore, or omnivore, you can find a food that is designed to meet the needs of almost any fish's diet. Most fish will learn to eat prepared foods such as pellets. If those don't work for you, almost all fish will learn to accept frozen foods which will probably contain a much better nutritional profile.

If you decide you still want to use live feeders for your fish, you can. Just be prepared to address the potential problems that might arise.

"Saltwater is too difficult"

Saltwater fish tanks scare a lot of fish keepers off. There are a number of techniques and concerns that a saltwater aquarist needs to be aware of that freshwater fish keepers don't. And they are undeniably more expensive than freshwater tanks, which can make it a lot more upsetting if you make a mistake that results in losing a lot of your fish. But are they really more difficult than a freshwater tank? Not necessarily.

Perhaps the biggest challenge is that many saltwater fish are more sensitive to problems than freshwater fish. Some freshwater fish seem to be bulletproof, able to handle anything a neglectful or poorly informed fish keeper may throw at them. Saltwater fish do require a bit more precision than freshwater fish.

There are also some concepts that only saltwater aquarists have to learn about and incorporate. For example, using live rock as a major source of biological filtration is something that doesn't happen in freshwater aquariums. Some equipment, such as protein skimmers, are only used in saltwater tanks. Tank stocking tends to be much lighter in saltwater tanks than in freshwater tanks. But for the most part, the overarching concepts and, perhaps most importantly, the maintenance tasks you are performing are largely identical between freshwater and saltwater.

In both fresh and saltwater aquariums, success comes down to doing research to ensure that you're giving your fish what they need to survive. This largely comes down to ensuring the correct water chemistry, not mixing incompatible fish, and ensuring you're removing waste products before they have the chance to accumulate and start causing problems.

How "difficult" a specific tank is going to be is decided by what your goals for that tank are and what you put in it. Any tank, whether fresh or salt, that is overstocked is going to be more difficult to keep healthy than a sparsely populated one. As you add additional animals aside from fish you introduce additional challenges. A full reef tank is going to be more challenging than one that is only fish and live rock, but a fully planted tank is going to similarly be more difficult than a freshwater tank with only rock and driftwood.

At the end of the day, your preparation and decisions will influence the difficulty of the tank more than whether it contains fresh or salt water.

MISTAKES

Putting your aquarium in a bad location

As they say, it's all about location, location, location.For the most part an aquarium can go just about anywhere in your home but there are a few places that can spell disaster. One of the most popular and best intentioned people consider placing an aquarium is in a area that receives direct sunlight or even in the window itself. For the most part this will not harm the fish, but it will have a huge impact on the growth of algae. It's possible to have this much light and not have algae problems, but it takes a lot of planning and effort to keep your water from turning green.

If you have the option, avoid placing your aquarium in these locations. If you do not have a choice, try using a heavy duty background on your aquarium to block out some of the light. There are a few background brands that can actually adhere to your tank, or you can even consider painting the back. Both require some practice but in the end will be worth it.

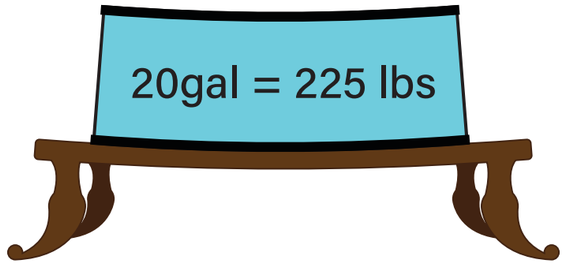
If you still have problems with green water, you can install a UV sterilizer. However, there are two downsides to using one for algae control. The first is that it addresses the symptom but not the cause. The second is that it will only help with free floating algae, not algae that is attached to a surface. As always, keeping your aquarium maintenance on schedule and the organics in the tank in check will help to keep the algae in control.

Rooms that are susceptible to large daily temperature changes do not make for a great choice to place your aquarium. Cold basements, bathrooms, and 3 seasons rooms (if you have one) are probably not the ideal place for tanks. Even with a good heater, the tank will likely not be able to regulate the temperature as quickly as the room temperature changes. Large temperature swings can stress fish out considerably as well as open the door for illness.

The best location for your new aquariums is in a place that receives ambient light, has a stable temperature and last but not least in a place that you will be able to enjoy it the most.

Having a bad stand

If you've ever had an aquarium crack or leak you suddenly realize you have a very large problem on your hands, or in this case on your floor. As we have mentioned in previous chapters, there are some do's and don'ts of what to trust your aquarium on. Ideally you will want to place it on a stand that is built for an aquarium. Many tanks will only honor the factory warranty if the tank was on an aquarium stand that is the same brand, so in many cases, it is worth the extra money.



Although your nightstand or table may be very sturdy, one of the largest factors in failure is slight imperfections that can cause the tank to be unlevel. There is a tremendous amount of pressure on the aquarium glass and when a tank is unlevel it is much more likely to leak or crack. If you're unlucky enough to have a tank that ruptures, the cleanup is not going to be fun. Imagine how much worse it will be if your tank is on a dresser that has clothes or valuables in it.

Even though the metal frame stands may not be very attractive, they can safely hold a substantial amount of weight. There are also a variety of wood stands available that are designed specifically for aquariums that are a much better choice.

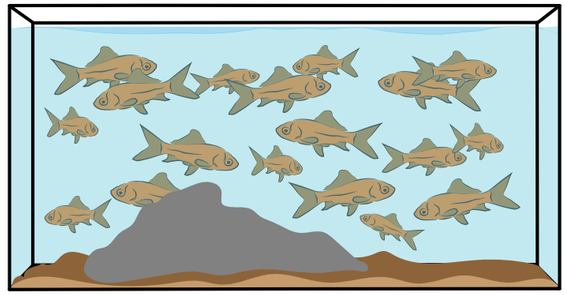
Overfeeding your fish

We've all heard it before. Someone sees their fish staring at the top of their tank, begging for food, decides the fish looks hungry, and feeds them more than they should be fed. Or your spouse or child comes along and feeds them whenever they think the fish wants food, ignoring your careful feeding routine. Many people become concerned with the fact that they did not see every fish eat. This often causes them to overfeed.

The fish's instinct tells them that they should eat whenever they have a chance because they don't always have the opportunity to eat on a daily basis in the wild. Most fish are quick to realize that you are their source of food. When you walk up to the tank, they are right there ready and waiting. Although feeding your fish is quite rewarding and entertaining, overfeeding can quickly have deadly results.

The more you feed your fish, the more waste they will produce. In the best case scenario, your biological bacteria colonies are strong enough to rapidly convert all of the extra ammonia that is being created into nitrate, but even then too much nitrate can be problematic. It's possible to overfeed to the point that the bacteria colonies can't consume the ammonia fast enough, quickly leading to deadly ammonia levels.

Carefully consider the best foods for each fish in your tank, and ensure you feed them only as much as they need. And then make sure nobody else is feeding them more.



Overstocking your aquarium

When you go to the local fish store, you are faced with a dazzling array of tanks, each teeming with life and activity. Each small tank may be filled with 20 goldfish or 50 tetras. It's easy to look at that tank and decide that's what you want in your house. Unfortunately, that would be a mistake.

Whether it's a result of the example your local fish store is setting or simply being overenthusiastic about your hobby, it's a quick trip to overstocking your tank. Retail stores overstock precisely because of how visually pleasing a full tank is. But they're able to get away with it for a couple of reasons. The fish in those tanks won't be living there for long, so they're able to live in conditions that aren't appropriate for their lifelong home. Those retail stores also have employees who are regularly cleaning those tanks, probably much more often than you will be doing it yourself.

The problem with overstocking your tank is the same problem you face when overfeeding your fish. You introduce too many nutrients into the water. There are countless times that an aquarist with half a dozen goldfish in a 10 gallon tank brings a water sample in for their store to test only to find out the ammonia levels are off the charts. Take the time to think about how many fish you can realistically put into your aquarium, and make sure to consider their size when full grown.

There is one potential exception to this, though. Many keepers will heavily stock tanks they're keeping African Cichlids in. This is done in an effort to spread out territorial aggression. The idea is that with more cichlids, it is harder for any single fish to establish dominance over the others or claim exclusive rights to a particular territory. Instead of having one or two weak fish be the target of aggression, all of the fish get picked on a little bit. However, if you are going to try this, you need to make sure your filtration is strong enough to handle the waste this stocking density will produce.

Buying the wrong water

When you start looking into the chemistry of aquariums, you quickly find out that not all water is the same. Many people assume that treated city water is the worst choice for your fish and that it's better to go to the store and buy bottle water. Sometimes, this can be a great option, but other times you may be doing more harm than good.

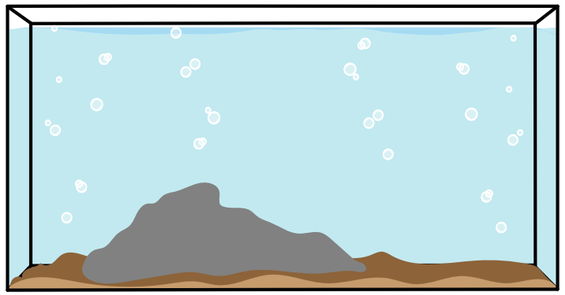
If you have a local fish store that sells prepared water, it probably will be a good option if you're uncomfortable with preparing it yourself. The store should be happy to tell you the important chemistry of the water (pH, hardness, salinity, etc), and as long as those values are appropriate for your fish then you'll be good to go. And if you have your own 5 gallon jugs, it tends to be fairly inexpensive.

You might have more problems if you go to your local grocery or big box store to buy generic water. Bottled spring water is often safe, but it can be impossible to know the source of that water, so you need to be careful. How hard or soft is the water? Did it just come from the tap at the bottling company (meaning it contains all of the same chemical treatments as your home aquarium)? Are there other problems you should be aware of? Bottled spring water can also be fairly expensive, so think carefully if it's worth it.

Distilled water is something of a double edged sword. The distillation process removes almost as many trace elements as possible, meaning you have ultra-pure water. While this means that there shouldn't be anything toxic in the water that would hurt your fish, it also means that there are not buffering agents to protect against massive pH swings. Also, unless your tank is already incredibly soft, you could run into problems if you change too much water too quickly and cause a major swing in the hardness of your water.

If your local fish store sells RO or RO/DI water, you can run into the same problems as with distilled water. The good news is that these challenges can be fairly easily overcome. If you're starting with distilled, RO, or RO/DI water, you can add commercially available buffers to your water in order to bring the hardness and pH into a level that will work for your needs.

Of course, any of the treatments that these waters have undergone can be done to your own tap water at home. Unless your local water source has a major problem, it might be best to just prepare your own water. But if you are going to buy water, be careful to avoid creating new problems in your aquarium.



Not being patient

If there's one quality that will ensure aquarium success more than any other, it's patience. When you keep a fish tank, you're setting up a living ecosystem, and it can take time for things to develop. You can only cycle your aquarium as quickly as your beneficial bacteria colonies can grow. If your local water has a lot of dissolved gases, it takes a certain amount of time for those to dissipate, so you will need to wait to add fish. If there are significant changes that need to be made (such as large pH adjustments), they should be done over a lengthy period of time. If you're keeping aquatic plants or live corals, it takes time for them to grow and fill out. If you're going to add a new fish to your tank, take the time to quarantine it before adding it to your main tank to ensure that it's properly acclimated and not going to introduce any diseases or unwanted hitchhikers.

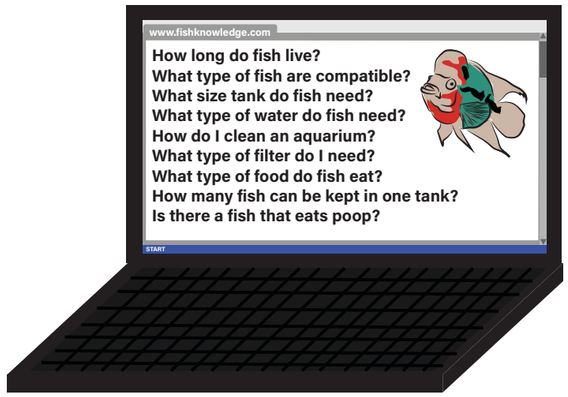
It's incredibly easy to get excited and want to have it set up and fully stocked immediately. Unfortunately, some things you just can't rush. You need to give time for everything in your tank to grow, develop, and mature. By rushing your tank, you create new problems that are going to take even more time and effort to fix. Take the time to do things right the first time.

Not doing your research

If there's one root cause to almost every problem that fish keepers face, it's this: not doing your research. The person who knows nothing about keeping fish thinks that all you need to do is throw it into water and give it some food. But there's a lot more to keeping fish than just that.

Before you bring home any fish, you need to know what you are getting into. How big does that fish get? How long does it live? Does it need to be alone or kept in a group? Is it going to get along with the other fish you have or will it try to eat it? What sort of water parameters does it need? What environmental factors should you try to provide it (e.g. does it like rocky caves? Cover from dense plants? Plenty of open swimming areas?)?

Most aquarium problems are easily avoidable if you take the time to do some research ahead of time.



GLOSSARY

Acidic
an overabundance of hydrogen ions and pH is below 7.0

Alkaline
or basic, is an overabundance of hydroxide ions and pH is above 7.0

Ammonia
NH_3, a water-soluble colorless gas, occurs when the water is an alkaline solution, toxic

Ammonium
NH_4^+, a water-soluble colorless gas, occurs with the water is an acidic solution, relatively harmless

Beneficial Bacteria
nitrifying bacteria that naturally eliminates ammonia

Biological Filtration
filtration that happens when you foster the beneficial bacteria colonies that break down nitrogenous waste

Biotope Aquariums
aquariums that focus on a specific area in the wild and use things you might find there

Blackwater
created when leaves, wood, and other plant matter release tannins into the water, staining it a sort of tea color

Canister Filter
a mechanical filter that pulls water through a hose into an enclosed shell, that houses filter media then pumps the clean water back into aquarium via another hose

Carbonate Hardness
a measure of the amount of carbonates dissolved in the water

Chemical Filtration
uses activated carbon to pull chemical substances out of the water

Clearwater
relatively clear and is the closest to the stereotypical aquarium

Closed System
a system that is fully self-contained

General Hardness
a measurement of the amount of calcium and magnesium salts in the water

Hang on Back Filter
a mechanical filter that hangs on the back of the aquarium

Hard Water
water with a high mineral content

Mechanical Filtration
a filter cartridge of a certain fineness to physically trap solid materials so that you can physically remove them from the water

Nitrite
a byproduct of beneficial bacteria using ammonia, toxic

Open System
a system in which materials or energy can be freely exchanged with the environment outside of that system

pH
a measurement of the ratio of hydrogen to hydroxide ions

Soft Water
water that has a low concentration of dissolved minerals

Sponge Filter
a filter that uses air flow to pass water through a sponge

Sump System
a slightly more complex mechanical flitration system, that directs water from the aquarium through a series of filtering processes in an external tank before pumping it back into the aquarium

Total Dissolved Solids, or TDS
a measure of all the dissolved substances that are present in water

Under Gravel Filter
a filter that goes under the substrate (gravel) of your aqaurium, using airflow to utilize the entire bed of substrate as one biological filter

Water Hardness
a measure of the amount of minerals dissolved into the water

Whitewater
extremely turbulent and as a result has a lot of air bubbles present, making it appear white