

How to Create an Organic Aquarium

*The Beginner's Guide to Soil-Based
Freshwater Aquariums*

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ACRE PRESS

an imprint of

Egg Publishing

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An imprint of

Egg Publishing

eggpublishing.com

First published 2025

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Edited by Sophie Judge

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Interior design by Wendy Mach (White Stone Pages)

Cover design by Wendy Mach (White Stone Pages)

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A catalogue record for this book is available from the National Library of Australia

ISBN: 978-1-763-71379-6 (Hardback)

ISBN: 978-1-763-71377-2 (Paperback)

ISBN: 978-1-763-71378-9 (eBook)

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Water

CAN I USE TAP WATER?

Tap water is the most common source of aquarium water. It contains a varied mix of dissolved minerals, metals, and chemical additives, which depend on your local water source, treatment process, and household plumbing. These elements influence how suitable your water is for aquatic life.

Chlorine or chloramine are added to tap water to make it safe to drink. While effective at killing harmful pathogens, these chemicals are dangerous to fish and microbes. Always treat your tap water before adding it to your aquarium. Even trace amounts of chlorine or chloramine can disrupt the ecosystem you're trying to establish.

Do not use a water conditioner that advertises multiple additional features as these can remove useful nutrients from the water¹⁹. Instead, use a simple conditioner that just dechlorinates.

HOW DO I TEST THE WATER?

As water travels through pipes and fixtures, it can pick up additional substances and change in composition (especially in older buildings). Test kits allow you to understand your water and track how your aquarium is progressing. Testing your water regularly is the best way to stay ahead of issues, especially once you have stocked your aquarium. For reliable results, invest in a liquid test kit that tests ammonia, nitrite, nitrate, pH, and hardness (GH/KH). The API® Freshwater Master Test Kit is the industry standard and is available through most aquarium retailers.

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AMMONIA, NITRITE, AND NITRATE

In an organic aquarium, testing for ammonia, nitrite, and nitrate (measured in parts per million, or ppm) helps you understand whether your system has reached a healthy balance between waste production and plant intake. Ammonia and nitrite are toxic to aquatic life, even in small amounts, and should always remain at zero. The presence of either suggests that the system is under strain, either because there aren't yet enough plants to absorb available nutrients, or because something is overloading the system. This might happen in the early stages of setup, if there's excess detritus, or if a cap is too shallow and releasing soil into the water column. Low, steady levels of nitrate are not uncommon and can be used to gauge whether your plant mass is keeping up with nutrient input.

Regular testing lets you catch these imbalances early and adjust before they affect the health of your fish, plants, or microbial community. If ammonia or nitrite is detected, or if nitrate levels are creeping too high, perform a 25–50% water change to protect your animals and restore balance.

PH

The pH (potential of hydrogen) of water measures its acidity or alkalinity on a scale from 0 to 14. A pH of 7 is neutral, values below 7 are acidic, and values above 7 are alkaline (or basic). Most freshwater fish are comfortable in water with a pH between 6.5 and 7.5, though individual species have specific preferences. Sudden or extreme changes in pH can stress fish and damage biological processes. Maintaining a stable pH within the tolerable range of your plants and animals is more important than achieving an ideal number.

GH AND KH

Water hardness describes the concentration of certain minerals in your aquarium, and it comes in two forms: general hardness (GH) and

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carbonate hardness (KH). These are measured in ppm or degrees of hardness (dGH and dKH). Some plant and animal species prefer soft water, while others require hard water to thrive.

General hardness refers to the levels of dissolved calcium and magnesium in the water. These are valuable minerals: they support bone development in fish, are a source of nutrients for plants, and are critical for healthy shell and exoskeleton formation in snails and shrimp.

Carbonate hardness refers to the concentration of carbonates and bicarbonates in the water. KH indicates the buffering capacity of the water, meaning its ability to resist changes in pH. Carbonate and bicarbonate ions act like a cushion against changes in acidity. When acids enter the water, these ions neutralise them, helping to keep the pH stable. A higher KH value stabilises pH, while a very low KH can result in sudden and potentially harmful pH fluctuations.

In an organic aquarium, moderately hard water (8–12 dGH) is good. Soft water lacks essential minerals needed for healthy plant growth²⁰. Fortunately, most tap water is moderately hard, but if yours is soft, its hardness can be increased.

For a built-in solution, you can add a small amount of Seiryu stone to your aquarium. This leaches carbonates and minerals over time. However, use it in moderation; too much can raise hardness excessively, and it's difficult to remove once integrated into the layout. A more flexible solution is to place crushed coral or oyster shells in a mesh bag inside a filter or near its outflow. These will also gradually raise general and carbonate hardness, whilst giving you the control to easily add or remove them as needed.

If there is a sudden KH drop or change in pH, you can add baking soda (3 grams per 10 gallons) to temporarily boost KH. Please note that this is a short-term fix only and should be used to stabilise the system while you find a long-term solution.

Avoid sulphate-based products like Epsom salts in an organic aquarium. In systems with accumulated detritus, excess sulphates can be converted by anaerobic bacteria into hydrogen sulphide, a toxic gas that harms plants and animals.

PH, KH, AND CARBON DIOXIDE

The relationship between pH, KH, and carbon dioxide is one of the main balancing acts in aquarium water chemistry. When carbon dioxide dissolves in water, it forms a weak acid called carbonic acid. This acidifies the water, lowering the pH. Carbonate hardness acts as a buffer. The carbonates react with the acid to form bicarbonates, preventing the pH from dropping too fast or too far. If KH is low (meaning there are fewer available carbonates), even small changes in carbon dioxide can cause big swings in pH.

Just as adding carbon dioxide lowers the pH, removing carbon dioxide causes the pH to rise. This happens throughout the day, when plants are photosynthesising and using up the available carbon dioxide, or when surface agitation (from an air stone or a hang-on filter) drives carbon dioxide out of the water. With less carbon dioxide in the water, there is less carbonic acid, so the pH goes up.

For example, if you have soft tap water with low KH and lots of plants, you might notice your pH reading 6.4 in the morning, but 7.6 in the evening. That's because your plants have depleted the carbon dioxide during the day, causing pH to rise.

These daily changes are called pH swings, and they can stress fish if they're too extreme. That's why it's important to keep a steady balance between pH, KH, and carbon dioxide. The goal is to have enough KH and carbon dioxide to maintain a stable pH (less than a one degree change) from day to night, helping fish and plants stay healthy and stress-free.

KH also affects the form of carbon available to plants. At higher KH and pH levels, carbon is more likely to exist as bicarbonate or carbonate ions rather than as dissolved carbon dioxide. Most aquatic plants can only use carbon dioxide directly, so when KH is too high, plant growth may slow. Finding the right KH level is a balancing act: high enough to stabilise pH, but not so high that it restricts access to carbon. However, some hardwater-adapted plant species (e.g. *vallisneria* and hornwort) can break bicarbonates and use them as an alternative carbon source.

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Including bicarbonate-using species can increase the system's resilience. As a rule of thumb, plants that can tolerate very hard water can use bicarbonates. Specific species have been flagged in the plant field guide at the end of this book for easy reference.

To find the right balance, aim for a KH from 3–9dKH. This provides enough of a buffer to keep pH stable without significantly reducing carbon availability. Watch for signs: if your pH changes more than one degree across the day, or your plants appear stunted or yellow despite good lighting, you may need to adjust. You can gently raise KH using the methods outlined in the previous section. If KH is too high, use distilled water or rainwater during water changes to gradually dilute the hardness.

TDS

As you start exploring aquariums, you may come across the term TDS (total dissolved solids). This is a general measure of everything dissolved in your water: minerals, nutrients, salts, waste byproducts, the lot.

So why do some aquarists track it? TDS helps you spot trends. If your TDS is steadily rising, waste is likely building up or your plants aren't absorbing nutrients fast enough. A sudden drop could suggest a major change in water chemistry, like after a big water change or equipment issue. TDS doesn't tell you what is in the water, only how much, so it's best used as a broad health indicator rather than a precise tool.

That said, you don't need to worry about TDS when you're just starting out. In this approach, plant density manages TDS naturally by absorbing many of the nutrients and waste compounds that contribute to it. Focus on the basics first: ammonia, nitrite, nitrate, pH, and hardness (GH/KH). These have a more direct impact on fish and plant health.

This might sound like a lot to manage, but a healthy aquarium is not the result of perfect parameters. Instead of micromanaging each parameter, focus on creating conditions where balance can emerge on its own. In practice, it's simpler – and more forgiving – than it first appears.