

How to Create an Organic Aquarium

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

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Substrate

WHAT KIND OF SOIL CAN I USE?

Soil is a mixture of mineral particles, organic matter, water, air, and living organisms. The proportion of these components varies depending on the soil used. When choosing a soil for an organic aquarium, the main decision is whether to use potting soil or topsoil.

NUTRIENT-RICH POTTING SOIL

Potting soils are widely available and designed to support terrestrial plant growth in containers. They have a high percentage of organic matter – up to 50% – including ingredients like peat moss, coco coir, composted bark, and humus (a nutrient-rich substance that forms in soil after organics are decomposed, not to be confused with the Levantine dip). Its rich organic content fuels fast root development and vibrant plant growth, which is rewarding early on. Yet, the higher nutrient content often causes initial ammonia spikes, cloudy water, and algae blooms, especially if the tank is not densely planted. This can be disconcerting when you are new to the hobby.

Potting soil must be chosen with care. These soils vary widely in ingredients, making it harder to ensure you're getting an appropriate, aquarium-friendly mix. Avoid anything that includes added fertilisers, water-retaining crystals, or synthetic wetting agents. Check the label

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for an NPK value (Nitrogen-Phosphorus-Potassium) and look for very low values – ideally below 0.10:0.05:0.05²¹. Products labelled as ‘organic’ are more likely to be free of synthetic additives, but you should still read the ingredients list carefully.

Another common issue with potting soil is the presence of perlite or vermiculite. These lightweight particles improve drainage in pots but float when submerged, creating a messy layer on your tank’s surface. While not harmful, they can be visually unappealing and difficult to remove once dispersed.

MINERAL-RICH TOPSOIL

Topsoil is lower in decomposing organics but rich in clay and minerals, which makes it good for steady, long-term plant health. As it has less organic material, it is less likely to cause initial algae blooms or ammonia spikes, making it the safer option when starting out.

Not all topsoil is created equal, and a little observation goes a long way towards choosing a soil that will support healthy aquarium life.

If sourcing soil from a garden centre, choose a product labelled simply as organic topsoil. Be cautious of soils labelled as ‘garden soil’ or ‘raised bed mix,’ as these often contain added fertilisers, compost, or wetting agents.

If collecting soil from your own garden, look for undisturbed areas away from roads and treated lawns. Dig below the surface – about 5–10 cm down – to access soil that hasn’t been exposed to any recent potential contamination.

Use your senses to identify promising soil: good soil should feel loamy, holding its shape when gently squeezed but crumbling apart with light pressure. It should smell earthy and rich, like a forest floor. If it smells sour, vinegary, or like rotten eggs, avoid it. These odours suggest excess anaerobic decomposition, which can introduce toxins and disrupt your aquarium’s balance. Look for dark brown or black soil with a mix of fine particles and small decomposed plant matter. Avoid grey, pale, or heavily compacted soil.

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The location where you dig influences the microbial composition of the soil. As a rough guide, soil from an area with fast-growing plants (like vegetable beds or grassy patches) is more likely to be rich in bacteria, which are the microbes most active in early decomposition and nutrient cycling. As explained by Lowenfels, these areas tend to support a bacterially dominated soil ecosystem, which mirrors the kind of microbial activity we want to encourage in our organic aquarium²². Avoid soil from shady, slow-growing spots like under trees or in dense brush, as these will be fungally dominated and decompose less predictably once submerged.

Only use soil from your own garden if you know it is free of contaminants. If in doubt, it is better to purchase a bag of topsoil.

OTHER OPTIONS

Some aquarists have had success using bagged pond soil, typically available at aquatic nurseries for planting in outdoor ponds. These products are generally composed of a dense mixture of clay, silt, and fine mineral particles, with minimal added organic matter. Because they are designed for submerged conditions, pond soils are less likely to cloud the water or leach excessive nutrients. Their composition naturally supports the development of an anaerobic-to-aerobic gradient that benefits aquatic plant roots and microbial communities. Though pond soil is harder to source, it is a great option.

In contrast, aquarium-specific plant substrates (the bags of small black balls you find in aquarium shops) are engineered for high-tech aquarium setups that rely on carbon dioxide injection and routine dosing with synthetic fertilisers. While these substrates can support robust plant growth in those systems, they are not suited to organic aquariums. These products do not have enough organic matter needed for decomposition, and they do not provide the microbial habitat required to sustain a low-tech, soil-based ecosystem. For anyone creating an organic aquarium, these products offer the wrong kind of support at a significantly higher cost.

HOW DO I PREPARE THE SOIL?

Once you've chosen your soil, the next step is to prepare it for your aquarium.

Start by spreading your soil out in a shallow tray, container, or even in the tank itself. Remove any stones or plant matter thicker than a pencil (e.g. sticks, large roots, rocks, or bark chunks). Removing these larger components will make layering easier and reduce the risk of plant matter floating up. Do not sift the soil. If it is reduced to a fine powder, you lower the number of organics available for decomposition and increase the risk of soil compaction due to its finer structure.

If your soil's structure is naturally fine and you are worried about compaction, mix the soil with inert gravel (5–10 mm diameter): approximately 1 part gravel to 3 parts soil will vary the soil's structure and ensure roots and water can still penetrate the soil layer.

Once again, trust your senses. Does the soil smell fresh and earthy, or is there a sour, chemical, or rotten odour? Is the texture crumbly and loamy, or is it powdery, gritty, or full of large chunks? What colour do you see? Dark brown or black is usually a good sign. It's natural to feel eager to move forward, but taking a moment to assess the soil now can save you a lot of frustration later. It's much easier to pivot at this stage than to troubleshoot a fully planted tank. If you're unsure, don't hesitate to ask for help. Online aquarium communities can be a great resource – someone may have used the same brand of bagged soil or had similar questions. (You'll find a list of recommended forums at the back of this book.) A second opinion from an experienced hobbyist can offer peace of mind before you commit.

Do not sterilise or bake the soil. Doing so destroys the beneficial microbial communities that help establish a soil-based tank in the first place.

What about mineralising soil?

If you have been researching soil-based aquariums, you have likely come across mineralisation discussions. In simple terms, mineralisation is a soil

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preparation method that involves soaking and drying soil repeatedly over several weeks. The goal is to pre-decompose unstable organic material before the soil enters the aquarium²³.

The process typically involves:

- Soaking the soil in water for 1–2 days
- Draining and allowing it to dry completely
- Repeating the soak/dry cycle 3–4 times.

The science behind mineralisation is straightforward. Each wetting cycle activates decomposing bacteria that break down organic compounds. The drying phase then kills many of these bacteria, making their cellular contents available as nutrients while removing the more volatile organics. The result is a more stable substrate that releases nutrients gradually rather than in the initial surge of organics typical of fresh soils.

This method can reduce early ammonia spikes and create a cleaner startup, especially when using nutrient-rich potting soils. Mineralisation is effective but time-consuming, and not necessary for success. If you're working in a small space, short on time, or simply eager to get started, this step is optional.

WHAT DO I USE FOR THE CAP?

There are two main options for your cap material: coarse sand, or fine gravel.

Sand can be sourced from your local garden centre or pool equipment shop. Choose products labelled as play sand or pool filter sand (with a grade of 16/30 or coarser). These are safe and cost effective options to use in your aquarium. Do not use construction sand as this has not been through the same screening process and can introduce contaminants into your aquarium.

If you would prefer to use a fine gravel, it is recommended to source this from an aquarium shop. Most gravels available from garden centres

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are too large or sharp for aquarium use. For an organic aquarium, we want to ensure a consistent particle size with a rounded profile. This will help form the oxidised microzone and ensure any bottom-dwelling animals are not injured.

Sourcing cap material from an aquarium shop will have a higher price tag; however, the result can be worth the additional cost if you have a specific aesthetic in mind for your aquascape.

HOW DEEP SHOULD THE SUBSTRATE BE?

As explained earlier, an organic aquarium substrate is made up of two layers: a soil layer, and a cap layer. Each has a specific role, and getting the proportions right supports these roles.

SOIL LAYER

In most aquariums, a soil depth of 2.5 cm is ideal. For tanks under 10 gallons, 2 cm is sufficient. Larger tanks can accommodate a slightly deeper soil bed – up to 4 cm – especially around larger rooted plants.

Place less soil in areas where you plan to position hardscape. Soil placed under hardscape can compact and turn anaerobic, especially if out of reach from plant roots. This can create toxins and, in extreme cases, throw your system out of balance.

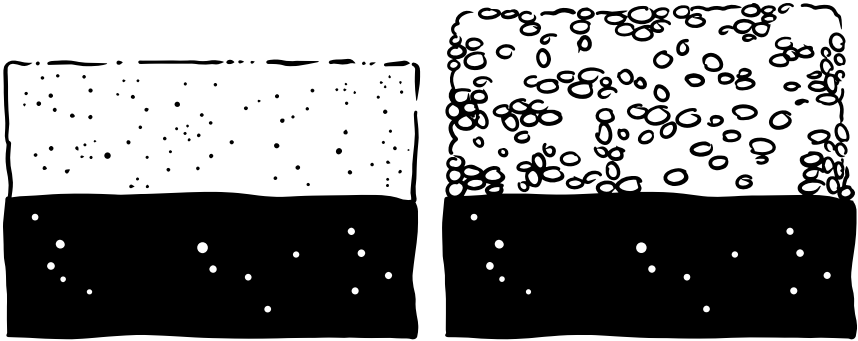
CAP LAYER

Cap depth should be scaled to match the particle size. As a rule of thumb, when using coarse sand (0.5–2 mm, about the size of granulated sugar) the cap depth should be 2.5 cm. When using fine gravel (2–3 mm, about the size of steel-cut oats) the cap depth should be 3.5–4 cm. Shallower than this will risk excess nutrients leaching into the water column. Do not use anything larger than pea gravel (5 mm, about the size of pepper corns), as it is too porous.

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Increase the depth of your cap if you see soil coming through, experience algae blooms, or have frequent ammonia spikes. Add in small increments of 0.5–1 cm until you have found a balance.

This allows for gentle water movement through the substrate while keeping the soil contained. To create an oxidised microzone, the cap must be breathable. A cap that is too fine or too deep can smother the soil, while one that is too coarse or too shallow risks not containing the soil below.



When adding these layers to your aquarium, you can estimate them. It does not have to be exact to the millimetre. However, it can be difficult to gauge the depth of the cap, especially in the central area of the aquarium. The easiest way to check your substrate depth is to transfer your desired soil and cap measurements onto a cocktail stick or coffee stirrer. You can then use it as a measure, checking depth against the marked lines by pushing it through the substrate.

HOW LONG WILL THE SOIL LAST?

Like any nutrient source, soil will not last forever – the carbon released through decomposition will eventually be depleted. Most substrates remain effective for around 2 to 3 years, though this depends on planting density, fish load, and water conditions²⁴.

You'll know the substrate carbon stores are running out when plant growth slows despite stable lighting and water parameters. Rooted plants

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may pale or stop producing new shoots. At that point, you can either begin routinely adding root tabs near heavy feeders or rebuild your aquarium with fresh soil.

Recognising this long-term cycle is all part of the ecosystem's natural progression.

WILL SOIL MAKE MY AQUARIUM WATER YELLOW?

It is natural for a soil-based aquarium to develop a slight yellow or tea-coloured tint. This comes from tannins in the soil and dissolved organic carbon released during decomposition. These compounds are beneficial to the ecosystem. The dissolved organic carbon binds to toxic metals and forms a protective coating on fish cells (especially their gills), helping buffer against acidity and trace pollutants²⁵. This tint is a hallmark of healthy substrate activity, not a sign of poor water quality.

If you want clearer water, increase the frequency of your water changes or temporarily use activated carbon filtration (if you are using a filter). Otherwise, embrace the tint as a feature of your aquarium. It adds a striking natural aesthetic and brings out the colours of your fish beautifully.

If you're finding the idea of adding soil to your new aquarium a little daunting, don't worry – you're not alone. There's a lot to take in at first; you shouldn't expect to do everything perfectly right away. What matters more is learning to observe and to stay curious.

DISCLAIMER: Even with careful planning and perfect execution, your aquarium may surprise you – and not always in good ways! Your water might turn the colour of strong tea from tannins, plants may stubbornly refuse to grow, or algae might throw an unexpected party. This isn't a reflection of your skills or attention to detail – it is simply nature being out of our control. These frustrations often teach us more than our successes. When things don't work out as expected, embrace the learning opportunity, document what happened, and share your experience with the online communities listed at the back of this book. Fellow aquarists love troubleshooting together, and your story might help someone else facing similar challenges. Remember: every experienced aquarist has a story that starts with 'Well, it didn't go as planned...'