

A PALUDARIUM

SARAH VASEND

I have had a fascination with orchids since childhood. As with many, it started with my grocery store phalaenopsis. I just loved watching the green fleshy roots crawl out of the tiny pots. Quite a few died along the way before I understood the unique needs of an epiphytic plant, but now my windowsills are spilling over with orchids of many varieties. It is a dangerous hobby indeed, and I found myself going farther and farther down the endless rabbit hole of orchid species. I bought my first miniature orchid a few years ago, *Aerangis punctata*. I just love the rounded, dark green, speckled leaves and the texture of its unique roots. For those of us without a large growing space, miniature orchids are a necessity. It was mounted on a small piece of cork, bare root with no sphagnum moss. It would get watered daily, but sadly I noticed it was not thriving. It immediately dropped two leaves and bloomed only

once. For two years, it produced no additional leaves or roots. I live in arid California, and even with daily watering, I suspected it was not getting enough moisture. As my collection grew, I realized that addressing the needs of different orchids was becoming more and more time-consuming. We all live busy lives, and sometimes I travel. Hiring a house sitter was a nightmare, and the thought of some of the more delicate orchids not being under my care for extended periods was stressful. I dreamed of one day creating a perfect enclosure for some of the smaller, moisture-loving orchids that would need minimal care, and finally, this spring, I put my plan in motion.

There are a few ways you could go about this, as I will discuss in more detail later, but my particular vision was more than just a miniature greenhouse. I wanted to recreate a scaled-down rainforest that I could view daily in my living room, complete with ferns and living mosses. For those of us who are familiar with creating terrarium-like environments, there are a few very specific problems that need to be addressed—light, air movement, moisture, and the inevitable development of mold and decay. In addition, I wanted it to be as automated as possible regarding lighting and watering. While seemingly a monumental task, if you take it step by step, it is not too difficult, and many of the materials are readily available.

Conceptually, I envisioned a main vertical growing space (mostly for epiphytic plants, ferns, and mosses) with a small water reservoir at the bottom, hence, a paludarium-type setup. A true terrarium is also possible with only a few minor modifications for those not interested in an aquatic portion. The enclosure I chose is glass, with dimensions of 18x36x36 inches (46x91x91 cm). It has two glass doors that swing open in the front with a simple locking mechanism. It also has about a ten-inch (25 cm) high reservoir at the bottom that can hold water, and the top of the enclosure is a simple removable mesh screen for air circulation. These enclosures come in various sizes and are generally available at most reptile stores. Common brands include Exo Terra, Reptizoo, and Zoomed.

The basic layout of the enclosure has a water reservoir at the bottom to catch excess moisture. The back has hardscaping with natural cork to accommodate epiphytes and mosses. I added an additional aquarium pump in the water reservoir to help filter and move the water, so it is not stagnant. If you were to make a true terrarium, you would simply fill the water reservoir with a false bottom substrate such as gravel or LECA balls, and there would be no real need for an aquarium pump. These setups are commonly seen with reptile enthusiasts that keep dart frogs and other moisture-loving species of reptiles and amphibians. As a small side note, an enclosure of such size filled with water



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Aerangis modesta



Plants in the paludarium.

and plants will be extremely heavy, in excess of a hundred pounds. I took steps to use the lightest materials possible to reduce the weight, and I chose an appropriate stand that could easily hold that weight.

Hardscaping materials are the next important consideration. By hardscaping, I am referring to the overall aesthetic as well as structural components on which plants will grow. One, I wanted to choose the lightest weight materials possible, and two, you do not want to choose materials that will rot or decay as, ideally, these materials will be permanent. As the bottom would be filled with water, an elevated section is necessary to have an area to grow plants. I stacked one-inch sheets of aquarium filter foam, cut out to the desired shape, and glued them with silicone to the back half of the paludarium to act as a filter for the water and to elevate and hold the substrate for growing. This ended up being about six inches (15 cm) high, with the water reservoir being about 5 inches (12 cm). I cut out a small square area in one corner of the filter foam to house the aquarium pump that would pump water through the filter. The substrate or growing media is also a critical consideration. The media must allow for adequate drainage and be resistant to rot but also be able to hold

moisture. I used a combination of aquarium sand, orchid bark, chopped sphagnum moss, and coco fiber. I recommend avoiding any type of potting soil as this will cause mold to form.

For the back of the enclosure (the vertical grow space), I used a combination of cork bark tubes to create a natural look to mimic a wooded rainforest and expanding pond foam to fill in the gaps and hold everything in place. Cork is an obvious choice due to its natural appearance, resistance to rot, and light weight. Many of us are familiar with small cork pieces and flats that we mount orchids on, but they also come in tubes and small branches, and I chose the latter for a more tree-like appearance. Expanding pond foam is also readily available. It comes in aerosol cans and can be purchased at most home hardware stores or online. It takes 24 hours to cure and will fill any gaps and hold everything in place. The pond foam also does not break down, is lightweight, and is non-toxic. After the pond foam fully expands and cures, it must be carved and cut down for a more natural look. Carving can be easily done by removing protruding portions of it with your fingers or with a razor scraper. Be careful not to do this when it is not fully cured! Uncured pond foam



Lepanthes calodictyon

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is extremely sticky and stains surfaces. Coco fiber was used to cover the exposed pond foam to retain more moisture for the background. A thin layer of aquarium silicone was used to adhere the coco fiber to the exposed pond foam. Small crevices and spaces were also carved within the foam to place ferns to add interest and foliage to the background. This portion of the build took several days as I filled in the gaps and built up the hardscape in stages, and after each stage, 24 hours of curing was required. When the background and hardscaping were completed, the enclosure was lifted onto its stand and moved into its final position before being filled with water and plants.

The next step for me was the most crucial as it would eliminate my need to physically water the plants daily. The installation of an automated misting system provided the necessary moisture and allowed me to travel and leave the house for periods without worrying about the demise of delicate and expensive orchids. Several are available on the market, but the system I used is MistKing. A few different kits are available, but they all have the same concept. A pump draws water from a reservoir and, via an automatic timer, delivers a fine mist spray from each nozzle attached to the system. You can customize the number of nozzles needed depending on the size of the enclosure. It comes with a pump, hoses, nozzles, and any hardware needed. You do need to obtain the reservoir separately, which is easily done. I have a three-gallon (11 liters) plastic reservoir that I purchased from a restaurant supply store and drilled a small hole on the side near the bottom for the outflow. I need to refill the reservoir about every three to four weeks. The mister turns on three times a day, at 8 AM, 2 PM, and 8 PM, and mists for one minute each time. With this amount of misting, there is a slight build-up of water in the main enclosure over time, so I remove some water once every week or so as the water level rises.

With the watering system installed and the hardscaping set, I was ready to plant! I wanted to create a very natural look, so I used a variety of plants to create interest and texture. I used two different types of mosses. Fern moss (*thuidium delicatulum*) has lanky fern-like fronds and a slow creeping habit. This was the main background moss to hide the brown patches of coco fiber and any visible pond foam. The fern moss came in small lightweight clumps, and stainless steel wire bent into a U-shape was used to secure it to the pond foam. Over time the moss will grow and continue to fill in background areas. Pillow moss (*leucobryum glaucum*) has a clumping type of growth. This moss can be easily broken apart, and I used it to fill small cracks and crevices within the cork bark to mimic the appearance of a mossy tree. I planted the bottom section of the paludarium containing the growing media with an *alocasia* sp. as well as *monstera adansonii* and *macodes petola*. For vertical background foliage, I used Korean rock fern (*polystichum tsus-simense*), creeping fig (*ficus pumila quercifolia minima*, *ficus pumila minima*), and *monstera dubia*. I also placed some other epiphytic plants, such as *vriesea raciniae* (a type of miniature bromeliad), and a few air plants for added interest.

Currently, I have fifteen orchid species and hybrids housed within the paludarium. All are miniature species that have been removed from their original mount/media and directly planted onto the background cork tubes and branches of the paludarium and secured with fishing line. The list includes *Aerangis modesta*, *Aerangis punctata*, *Aerangis* unregistered (*punctata* × *luteoalba* var. *rhodosticta*), *Angraecum urschianum*, *Bulbophyllum lasiochilum*, *Cattleya cernua*, *Lepanthes calodictyon*, *Masdevallia decumana*, *Masdevallia herradurae*, *Macodes petola*, *Vanda* (*Neofinetia*) *falcata*, *Phalaenopsis* Joy Fairy Tale '3 lips,' *Phalaenopsis bellina*, *Phalaenopsis* unknown hybrid, *Schoenorchis fragrans*, and *Schoenorchis fragrans*. I tried to choose small orchids with high moisture requirements that do better in terrarium environments. Thus far, I have had two orchids bloom since planting in May—*Aerangis modesta* and the unknown *Phalaenopsis* hybrid. I have had one orchid loss—a *Phalaenopsis* (*Sedirea*) *japonica*, which did not seem to tolerate the thrice daily misting (the leaves quickly turned yellow at the base and rotted off). I have seen new leaf and root growth for the remainder of the orchids, and I hope to see more blooming in the coming year. Great news on my poor *Aerangis punctata*—it has formed three new leaves since rehoming it in the paludarium, the first new leaves it has produced since I've had it!

There are a few more details to discuss. For lighting, I chose a LED light that is programmable and designed for planted aquariums (Fluval Plant 3.0). It has a smartphone app that allows you to set a schedule. It turns on around 7 AM and turns off by 6 PM. If desired, you can even choose pre-programmed settings to mimic various parts of the world or customize your own. It has a moon phase at night that lasts a few hours after sunset.



The paludarium.

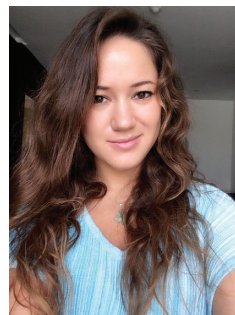
To address air movement, I did not install a fan as I open the glass doors a few times a day, but if I were to see issues with mold, this would be a consideration. Small terrarium fans are available online and can be attached to the screen portion at the top of the enclosure or the glass walls. For further control of mold and decay, there is some microfauna that has been introduced. Springtails (*Collembola sp.*) are tiny insects common in the terrarium world used as a clean-up crew. I also have powder orange isopods (*Porcellionides pruinosus*) that live and tunnel in the substrate, aerating the substrate and consuming decaying matter.

I also have a few additional inhabitants that make it a true ecosystem. A small colony of Tiger Endler fish (*Poecilia wingei*), kuhli loaches (*Pangio kuhlii*), and shrimp (*Caradina cantonensis*) live in the aquatic portion. A few vampire crabs (*Geosesarma dennerle*) are semi-aquatic. At the top of the enclosure, I have three tiny mourning geckos (*Lepidodactylus lugubris*) that come out at night and eat the fungus gnats that find their way into the paludarium. Maintenance is fairly minimal. I feed the fish and geckos daily. The crabs seem to find detritus to eat on their own. I fill the pump reservoir every three weeks or so with reverse osmosis water, and I also need to remove water from the enclosure from time to time. Eventually, I will also likely need to trim back growth on some of the moss and other plants that will continue to grow. I recently left the country for two weeks, and

my notes to the house sitter were much simpler. I was happy to come back and see my tiny rainforest thriving.

A paludarium is a beautiful, fun, and practical alternative to a greenhouse for those of us limited in space or simply do not have the time or ability to water daily. The beauty of it is that you can create something very specific to suit your needs, i.e., you could create a true terrarium with a false bottom to hold excess water or hang orchids on their original mounts if you wish to preserve them individually as specimens. All it takes is planning and creativity! I hope my project inspires others to create a tiny oasis of their own, and I wish you good luck and happy growing!*

About the Author



Sarah Vasend was born in Thousand Oaks, California, and currently resides in Concord, California. She is a practicing small animal veterinarian passionate about orchids and SCUBA diving.

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