

Problem

- Americans spend 90% of their time indoors, breathing in volatile organic compounds (VOCs) at up to 10 times the concentrations of outdoor air¹.
- Volatile organic compounds are especially harmful and can lead to headaches, fatigue, and, in some cases, cancer.
- VOCs are abundant indoors as they are released from flooring, cleaning supplies, paint, building materials, and more³.
- Physical filters are components in all air conditioning systems, but can become clogged over time and even add to air contamination⁴.

Solution

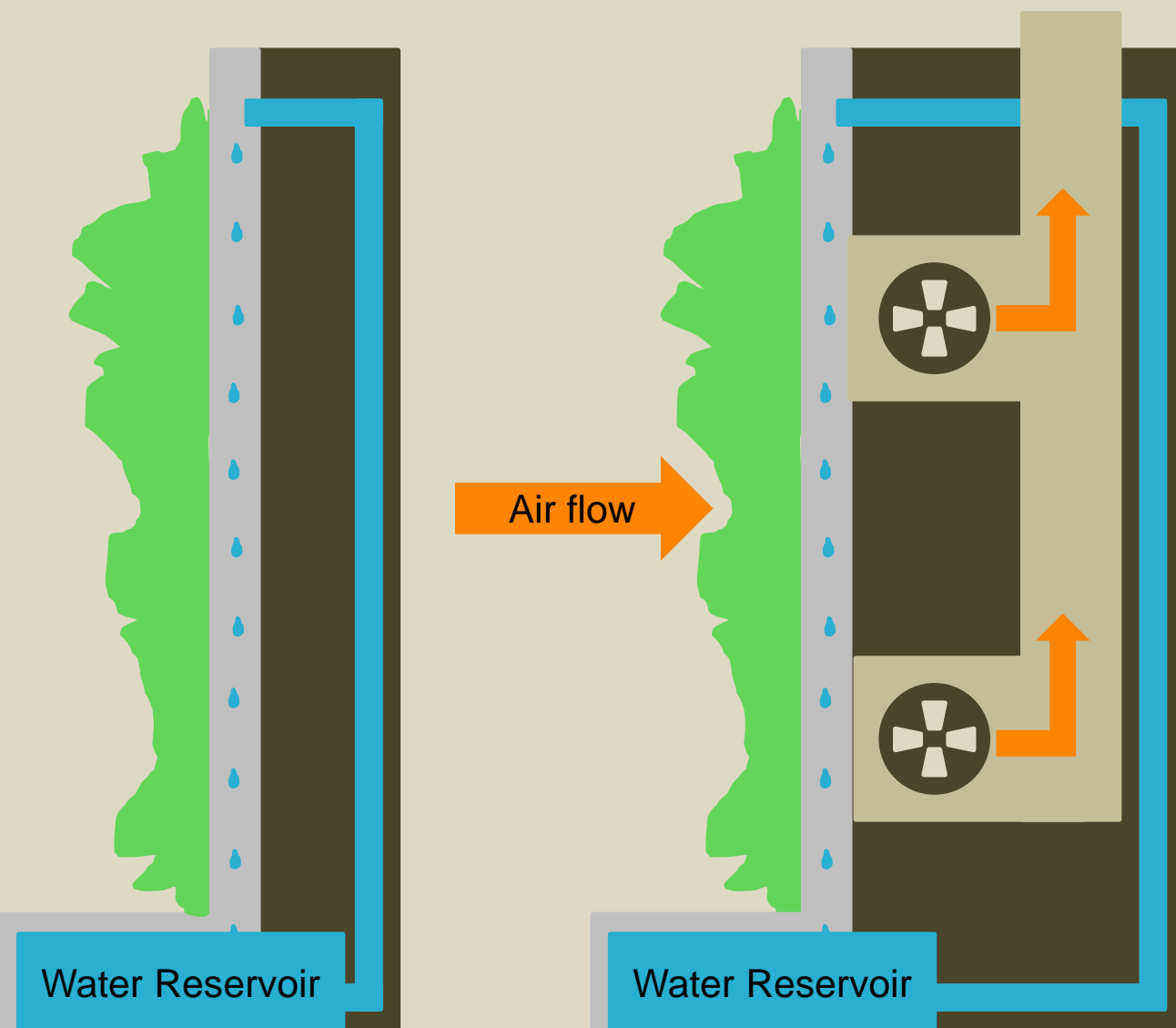


Figure 1. A) Passive system where the only interactions between the plants and the air occur on the leaves. B) Active system in which air is pushed over the root zone to be filtered and then incorporated into the HVAC system.

- Biowalls are vertical structures covered in plants which aim to naturally filter toxins from indoor air.
- Active biowalls are more effective at degrading VOCs, but can be high maintenance as well as energy and water intensive⁵.
- Passive biowalls are far less effective at air filtration, but are also inexpensive and easy to maintain when compared to active biowalls⁵.
- Our team aims to redesign a current industry passive model to obtain effective air filtration while minimizing costs and resources.



Figure 2. Biowalls designed and maintained by Furbish Company, whose industry model we will be working with.

Previous Research

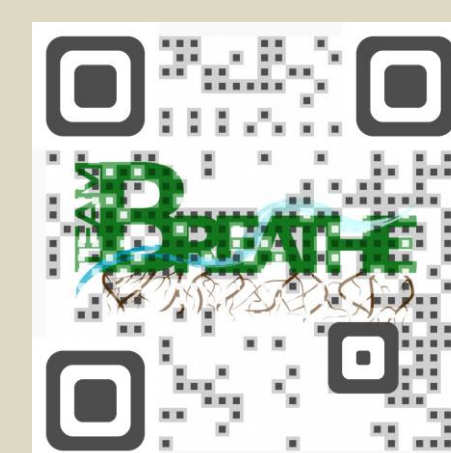
- Previous research focused on phytoremediation of VOCs through plant leaves^{6,7,8}.
- Recent research has indicated that microbes on plant roots drive the purification abilities of biowalls⁹.
- Hyphomicrobium* spp. in particular were shown to increase in concentration in the presence of VOCs⁹.



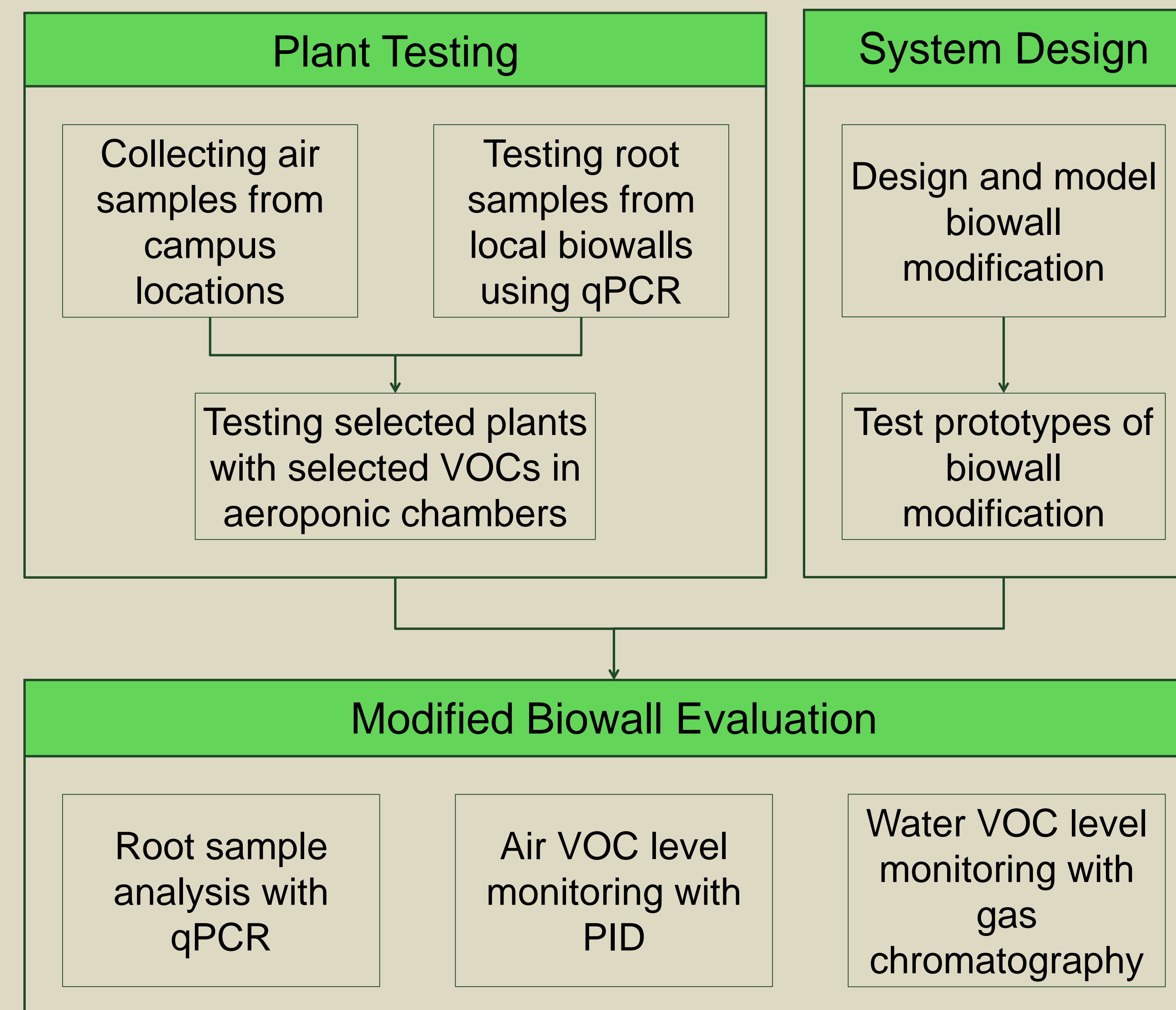
Figure 3¹⁰. A strain of *Hyphomicrobium*, initially researched for wastewater treatment. Bar, 1micron.

References

To see the references used, follow the QR code to the right or go to ter.ps/sources.



Methodology



Anticipated Results

- Certain plants will favor the growth of *Hyphomicrobium* spp. over other plants due to different root structures and secretions.
- Results from Drexel University⁹ will be confirmed by finding that *Hyphomicrobium* spp. concentrations increase in a VOC-rich environment and that VOC levels decrease after exposure to the bacteria on the roots.
- Both VOC levels and *Hyphomicrobium* spp. concentrations will be significantly different between the modified and unmodified biowall designs.

Campus Applications

- An indoor biowall on a college campus would
- Improve productivity, happiness, and health of students.
 - Attract prospective students and visitors.
 - Show a commitment to sustainability.