



Adams R, Bhangar B, Dannemiller K, Eisen J, Fierer N, Gilbert J, Green J, Marr L, Miller S, Siegel JA, Stephens BR, Waring MS, Bibby K. 2016. Ten questions concerning the microbiomes of buildings. *Building and Environment*, **109**, 224-234. DOI: [10.1016/j.buildenv.2016.09.001](https://doi.org/10.1016/j.buildenv.2016.09.001)

### Abstract

Buildings represent habitats for microorganisms that can have direct or indirect effects on the quality of our living spaces, health, and well-being. Over the last ten years, new research has employed sophisticated tools, including DNA sequencing-based approaches, to study microbes found in buildings and the overall built environment. These investigations have catalyzed new insights into and questions about the microbes that surround us in our daily lives. The emergence of the “microbiology of the built environment” field has required bridging disciplines, including microbiology, ecology, building science, architecture, and engineering. Early insights have included a fuller characterization of sources of microbes within buildings, important processes that structure the distributions and abundances of microbes, and a greater appreciation of the role that occupants can have on indoor microbiology. This ongoing work has also demonstrated that traditional culture- and microscopy-based approaches for studying microbiology vastly underestimate the types and quantity of microbes present in environmental samples. We offer ten questions that highlight important lessons learned regarding the microbiology of buildings and suggest future areas of investigation.

### Highlights

1. Research interest in the microbiology of the built environment has increased in recent years.
2. The built environment houses a **great diversity** of microorganisms.
3. Emerging research has elucidated the **sources** and **spatial, temporal, and taxonomic distribution** of microorganisms in buildings.
4. Building **operation, ventilation, and occupancy** drives the building microbiology.
5. The role of built environment microbiology on occupant health is an active area of research.

### Ten Questions:

1. *What does the microbiome of a typical indoor environment look like?*
2. *How do building characteristics, including occupants and their behaviors, influence the indoor microbiome?*
3. *How do moisture problems alter typical indoor microbiomes?*
4. *How does the microbiome affect indoor chemistry, and how do chemical processes and the composition of building materials influence the indoor microbiome?*
5. *What do DNA sequencing and modern analytical techniques tell us about the indoor environment?*
6. *What are appropriate sampling methods and constraints for studies of the microbiology of the built environment?*
7. *What technological developments will enhance our understanding of the microbiology of the built environment?*
8. *What are the connections between indoor microbiomes and occupant health?*
9. *What are the implications of recent work for building design and maintenance?*
10. *What do all these recent studies NOT tell us?*

