

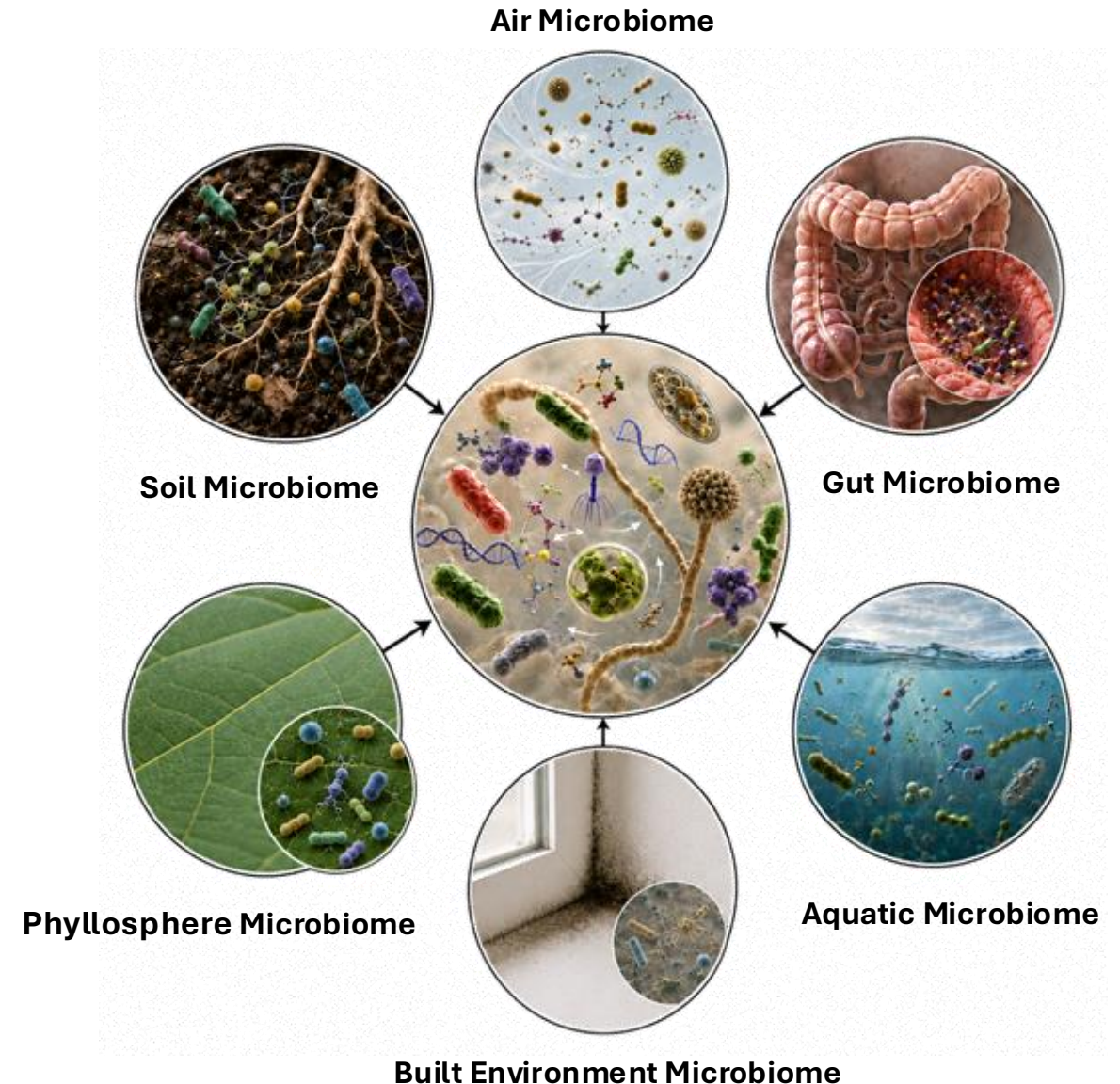
Lesson 1: Building the Foundation for Indoor Fungal Microbiome Analysis

What Is a Microbiome?

- **Microbiota = Who is there**
Living microorganisms in a specific place: bacteria, archaea, fungi, algae, and protists.
- **Microbiome = Who is there + what they do**
microorganisms (**archaea, bacteria, fungi, protists, algae, and viruses/phages**) in a specific environment, plus their genes, molecules, interactions, and surrounding environmental conditions.
- **Key idea:**
A microbiome is a tiny ecosystem where microbes live, interact, compete, cooperate, and influence their surroundings.
- **Memory aid:**
Microbiota = organisms
Microbiome = organisms + genes + activity + environment

Berg et al. Microbiome. 2020 Jun 30;8(1):103.

Microbiomes: Invisible Communities Across Natural and Human-Associated Environments



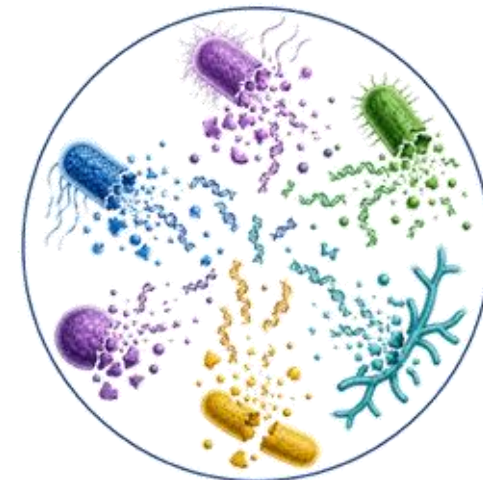
Why Study the Indoor Microbiome?

- **We spend much of our time indoors.**
Indoor microbes can influence the air we breathe and the surfaces we touch.
- **Some indoor microbes can become health hazards.**
Moisture and poor ventilation can support mold, bacteria, allergens, and microbial particles.
- **Indoor microbiomes affect air quality.**
Microbes and their molecules can contribute to odors, irritation, allergies, asthma triggers, or infection risk.
- **Understanding the indoor microbiome helps us manage buildings better.**
Scientists can detect risky microbial growth and identify conditions that promote healthier indoor environments.

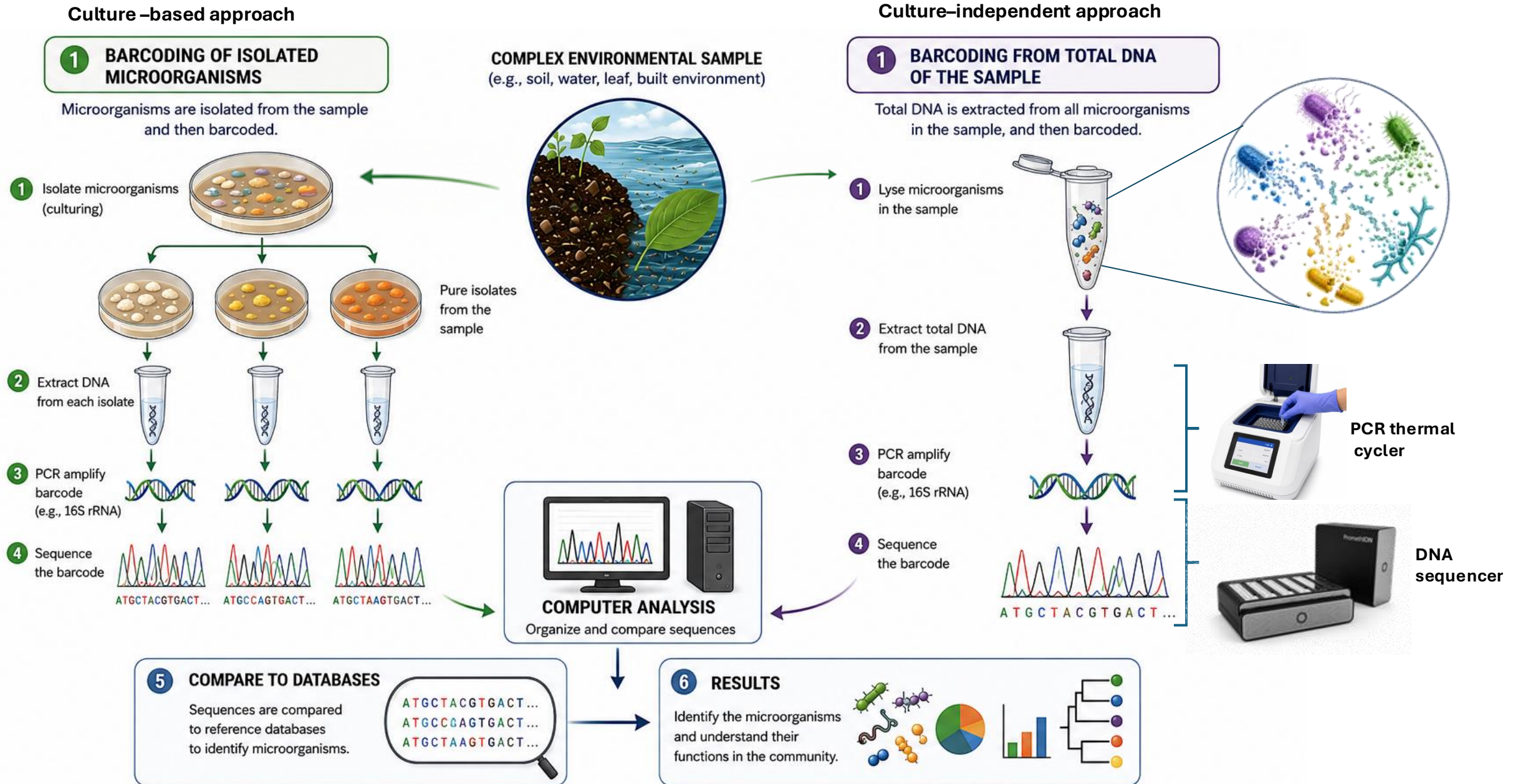


Modern microbiome research combines DNA-based techniques, sophisticated lab instruments and computer analysis tools to understand invisible microbial communities present in complex environmental samples.

- One technique used to identify microorganisms is called **DNA barcoding**. It analyzes a short, standardized region of DNA that acts like a barcode, allowing scientists to distinguish one microbial species from another.
- DNA barcoding can be applied to microorganisms isolated (cultured) from a sample or to the total DNA extracted directly from the sample, which represents the entire microbial community (culture-independent approach).
- Culture-dependent DNA barcoding identifies microorganisms that can be grown as pure cultures in the laboratory, allowing additional studies on living isolates.
- Conversely, in the culture-independent approach, all microbial cells in the sample are broken open (lysed) to recover their DNA. Because DNA is collected from the entire sample, scientists can identify both culturable and non-culturable microorganisms, providing a more complete description of the microbial community.



DNA barcoding can identify microorganisms one isolate at a time, or it can help describe a whole microbial community directly from a sample.



Just as a UPC code links a product to information in a store database, a DNA barcode sequence links a microbial species, such as a fungus, to information stored in a genetic database.

EVERYDAY LIFE		BIOINFORMATICS	
1	UPC Code  A unique code that identifies a product.	➡	ITS Sequence (a fungal DNA barcode) <pre>AGTCTGGTGAACCTGCCGG TCATCGATGAAGAACGCAG AAGTAAACTCGCGTTGTT TCCGTAGGTGAACCTGCCG ...</pre> A unique DNA sequence (ITS region) that identifies a fungal species.
2	Supermarket Scanner  Reads the UPC code from the product.	➡	BLAST Program  Basic Local Alignment Search Tool https://blast.ncbi.nlm.nih.gov/Blast.cgi?PROGRAM=blastn&PAGE_TYPE=BlastSearch&LINK_LOC=blasthome Reads the ITS sequence and searches for similar sequences.
3	Valuemart Database  A large database that stores information about products.	➡	GenBank Database  https://www.ncbi.nlm.nih.gov/genbank/ A large public database that stores DNA sequences from many organisms.
4	Product  The item being identified in the store.	➡	Fungal Species  The organism being identified using its ITS sequence.