

Environmental Microbiome of Asthmatic Homes

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Microbiome

Definition

The community composition of microorganisms in a niche

Capabilities of Microbiome

- Diversity of niche
- Relationships between samples
- Composition of niche

Limitations of Microbiome

- Relative abundances
- Functional information is missing
- Sequencing length limits depth of taxonomic classification

Microbiome Sequencing Methods

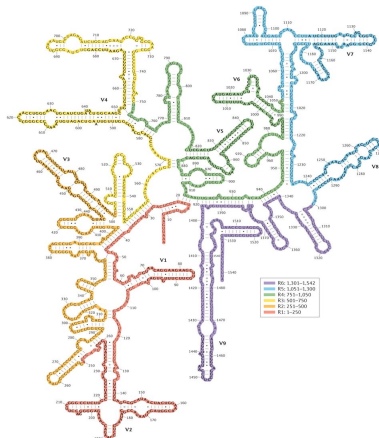
Conserved Universal Gene

16S ribosomal RNA:

A genetic element found across all prokaryotes

Regions of 16S

Contains alternating segments of conserved and hypervariable regions allowing for amplification and differentiation



Nature Reviews | Microbiology

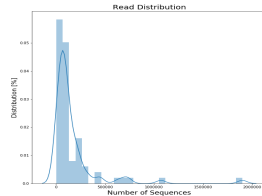
Yarza, P, et al. (2014)

BRASS Data Collection

BRASS Study Swabs (76 total)

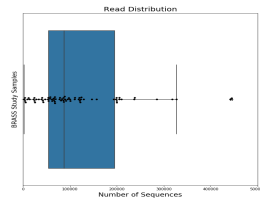
- Swabs from 7 patients' homes
- 1 to 3 visits per patient
- 7 study sites

Read Distribution



16S Sequencing

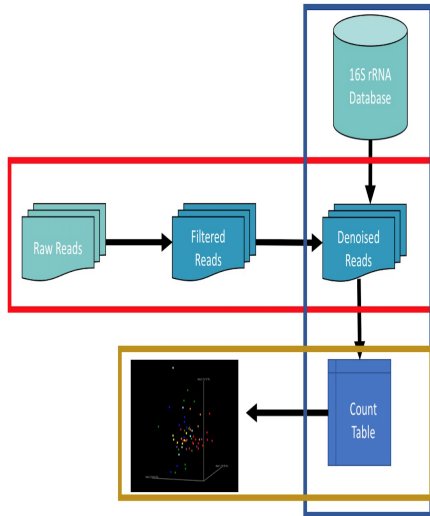
- Reads generated on Illumina MiSeq
- More than 12 Million Paired End Reads



Qiiime2 Workflow

Operations

- Illumina error correction
- Taxonomic assignment
- Diversity metrics



Illumina Error Correction

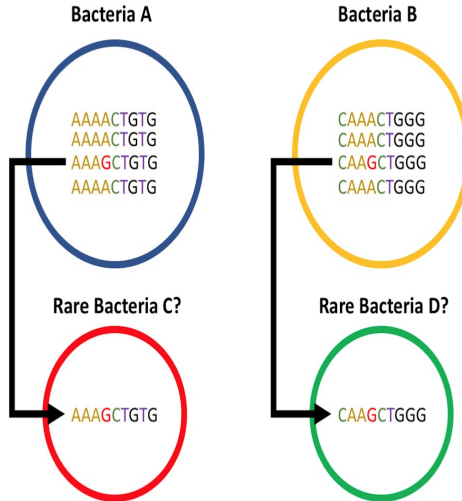
Bacteria A



Bacteria B

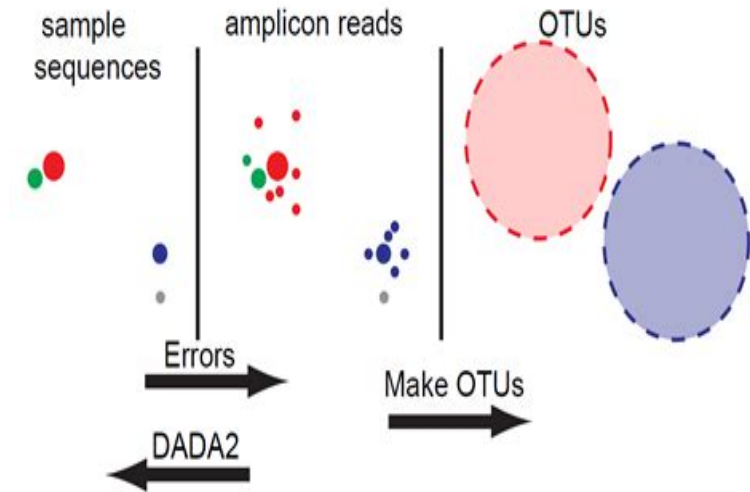


Illumina Error Correction



Workflows

Illumina Error Correction



Workflows

Taxonomic Assignment

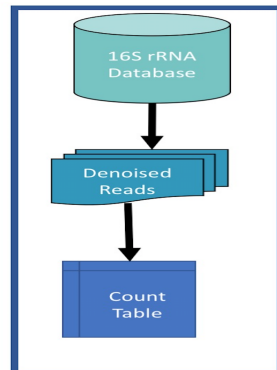
Taxonomy Classifier

Assign raw reads with a Naive Bayes classifier trained on 16S Database

16s rRNA Databases

GreenGenes

Silva 132 (Troubleshooting)



Diversity Metrics

Alpha Diversity

Richness or organismal diversity of samples

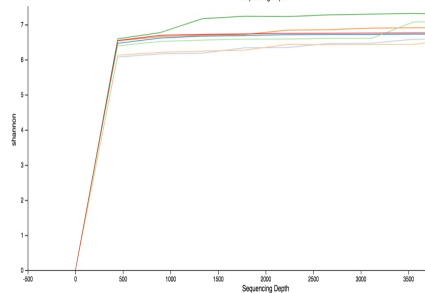
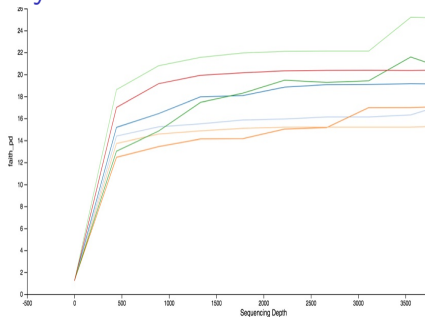
- Faith's Phylogenetic Diversity
Tree Based Alpha Diversity Estimate

- Shannon Diversity Index

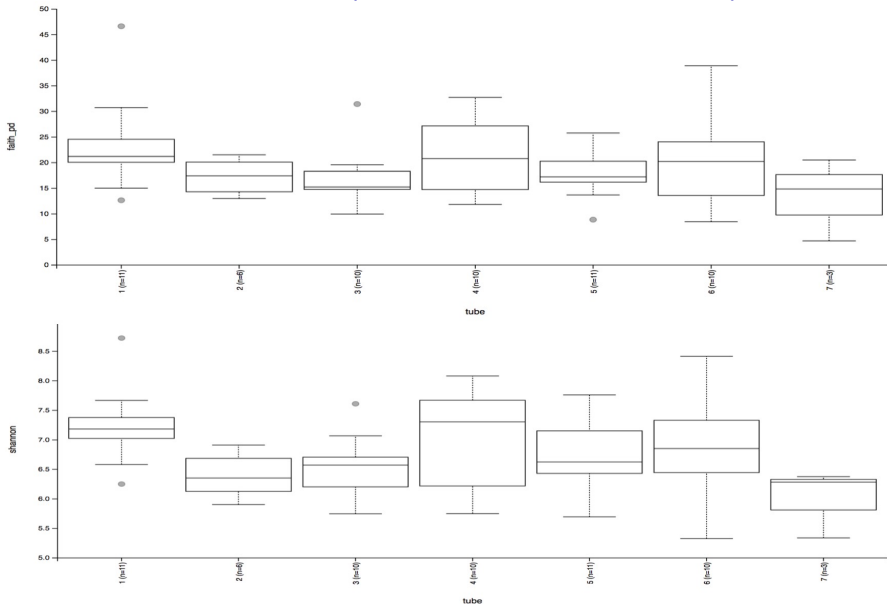
$$H = - \sum [(p_i) * \ln(p_i)]$$

$$E = H / H_{max}$$

$$SI = \sum [E_i]$$



Diversity Metrics (Alpha Diversity Barplots)



Diversity Metrics

Beta Diversity

Evenness or distances of counts between samples

Weight Unifrac

Measure takes into account abundances and phylogeny

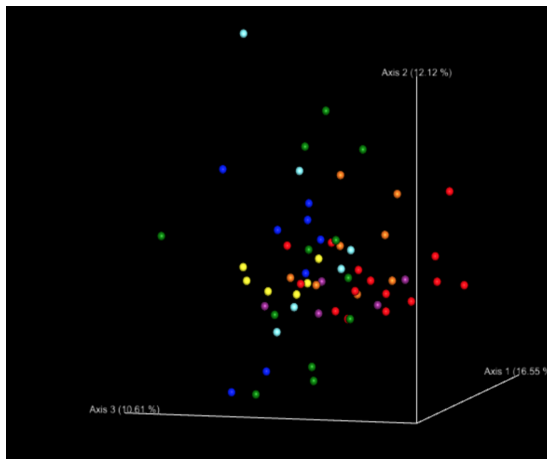
PERMANOVA

Distances within a group is more similar to each other than outside group

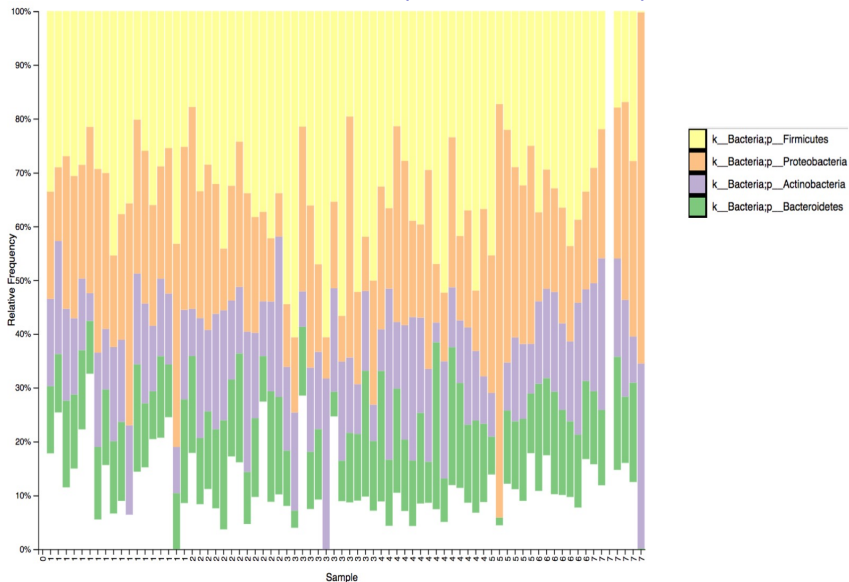
Significance

By House: $p < 0.001$

By Tube: $p < 0.001$



Diversity Metrics (Taxa Bar Plots)



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Questions?

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