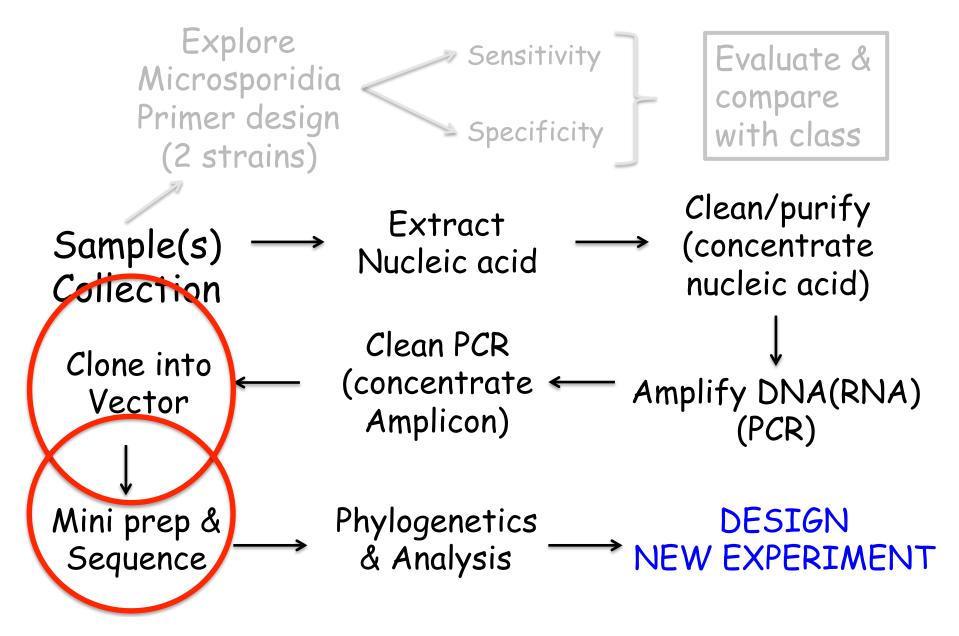
20.109 Laboratory Fundamentals in Biological Engineering

Module 1
Nucleic Acid Engineering
Lecture 5

Office hours: by appt.

Module 1



Sequence analysis

UniFrac?

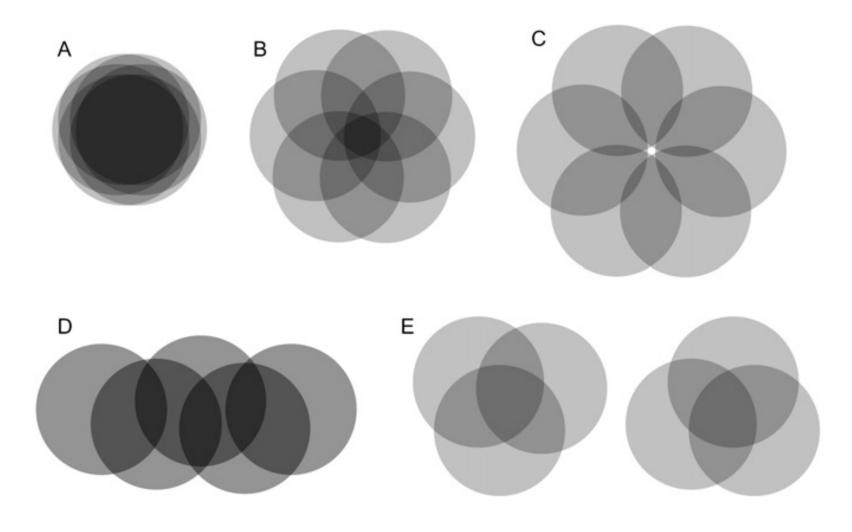
- 1) Alpha and beta diversity
- 2) Qualitative or quantitative ? unweighted or weighted
- 3) Phylogeny or taxon based

Back to the core questions

- What is the basic stucture and behavior of host associated communities?
 - Measure → model

- How might we possibly fix/engineer it?
 - Manipulate → make

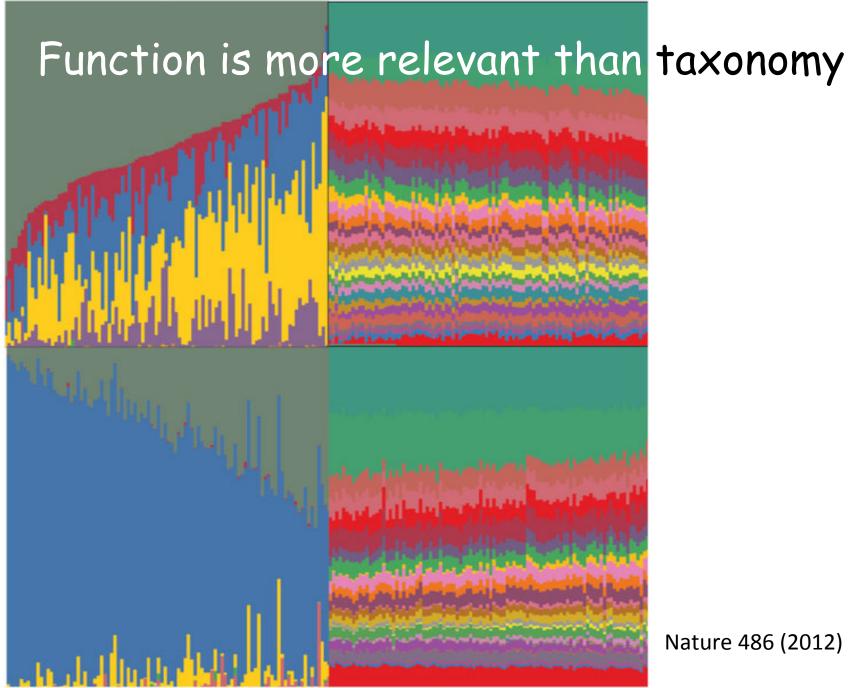
Models of a core microbiome



If taxonomy is not conserved, what does that mean for function?

- Functional core?
- Interchangeable parts?

Phylum Function



Nature 486 (2012)

How do you examine structure/function?

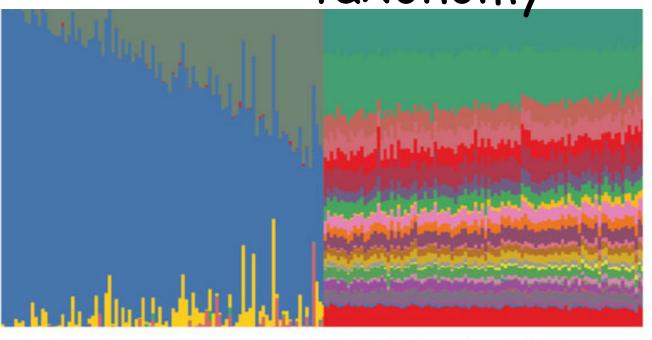
- data cleanup
- derivative data sets (pathways, OTUs, reference alignments, etc...)
- Trees and relationships of communities (abundance curves, biodiversity plots, variant identification, etc...)

Exploring function through collective databases

National Center for Biotechnology Information

Kegg pathway database

Function is more relevant than taxonomy





Actinobacteria

Bacteroidetes

Proteobacteria

Fusobacteria

Tenericutes

Spirochaetes

Cyanobacteria

Verrucomicrobia

TM7

- Central carbohydrate metabolism
- Cofactor and vitamin biosynthesis

Oligosaccharide and polyol transport system

Purine metabolism

ATP synthesis

Phosphate and amino acid-transport system

Aminoacyl transfer RNA

Pyrimidine metabolism

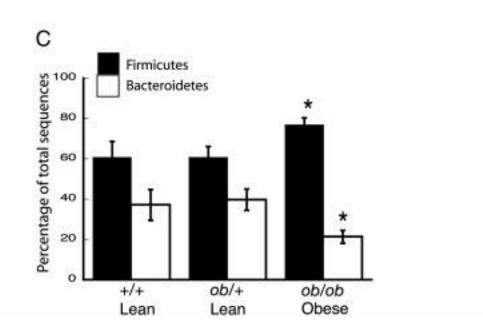
Ribosome

Aromatic amino-acid metabolism

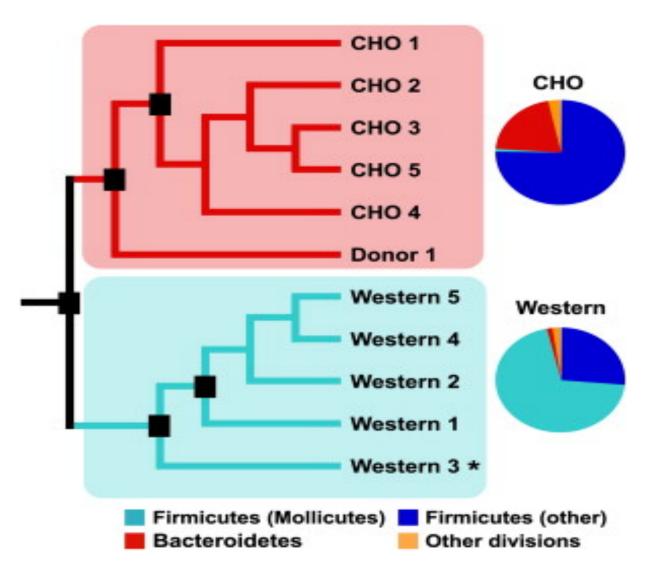
Nature 486 (2012)

Does diet affect microbial composition?

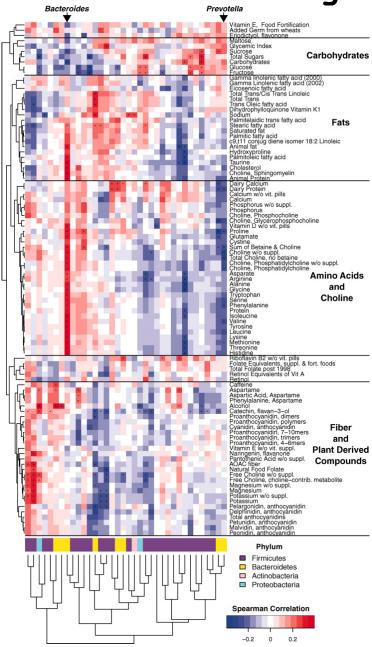
 Genetically Obese mice harbor a significantly different community than lean conventional mice



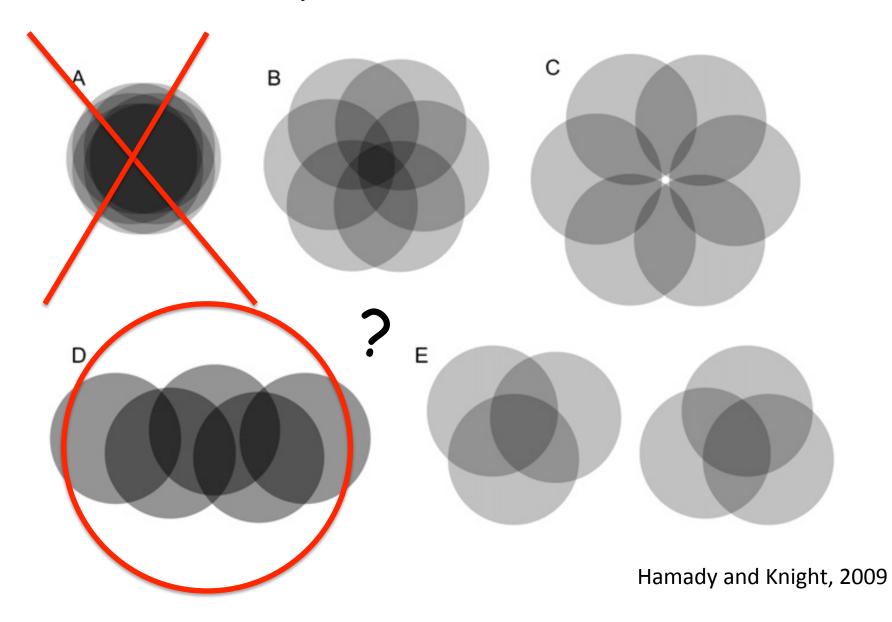
Diet affects microbial composition



Correlation of diet and gut microbial taxa

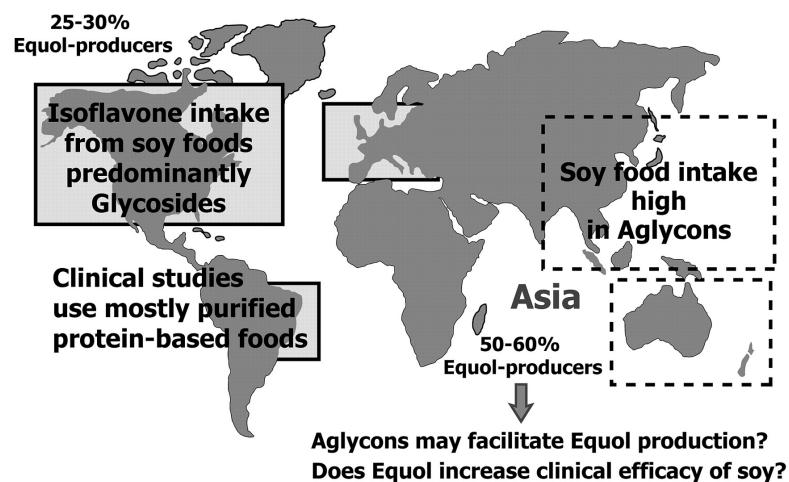


Models of a core microbiome

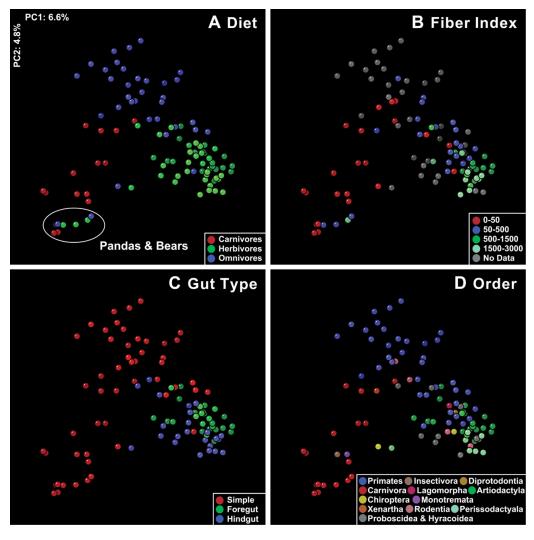


The type of food consumed may account for microbiome function

Western World



Mammalian fecal bacterial communities clustered using PCoA



Other factors affecting microbiota structure

- Antibiotic treatment or other drugs
- Physiological state (pregnancy, age, gender, etc...)
- Population (genetics?) ethnicity
- Disease
- Other?

Cause or effect?

Evaluation of a diagnostic test

Sensitivity

Specificity

Module 1

Explore
Microsporidia
Primer design
(2 strains)

Sample(s)

Structure Behavior Sensitivity

Specificity

Evaluate & compare with class

Test specificity – the likelihood of a negative test result in samples known to be free of the microbe (pT-/D-). aka – "true negative rate"

Test sensitivity - the likelihood of a positive test result in samples known to have the disease (pT+/D+). aka - "true-positive rate" or "operational sensitivity"