# QIIME 2 - pipeline for performing metagenome analysis

presentation made by Anastasia Ramanchanka

# Understanding of microbiomes may leads to...

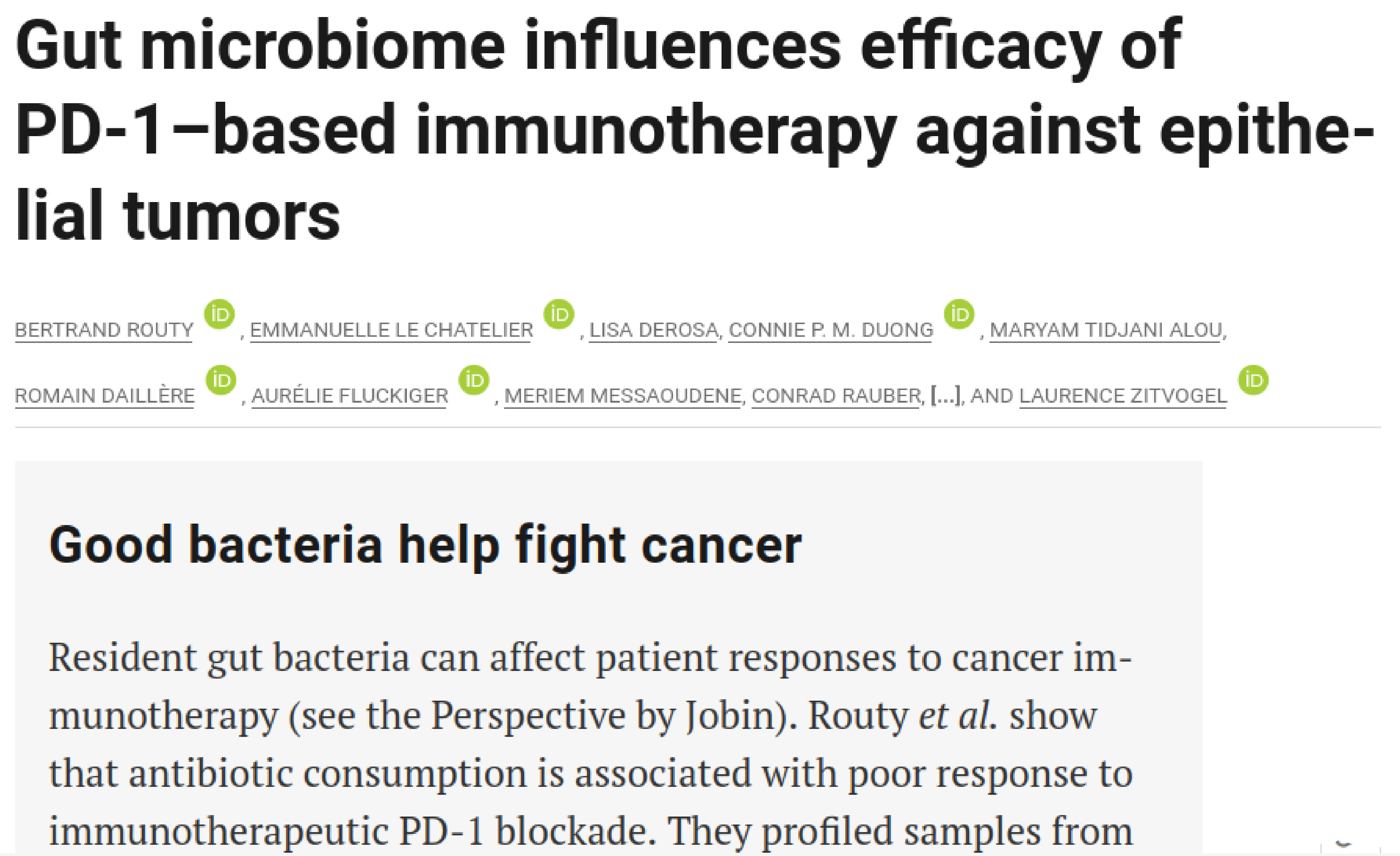
**..insights into the role of microorganisms in health and disease.**

**..help in the development of probiotics, prebiotics, and other microbiome-based therapies.**

**..more sustainable farming practices.**

**..support the  protection and restoration of ecosystems.**

# Our microbiomes impact the efficacy of medical treatment

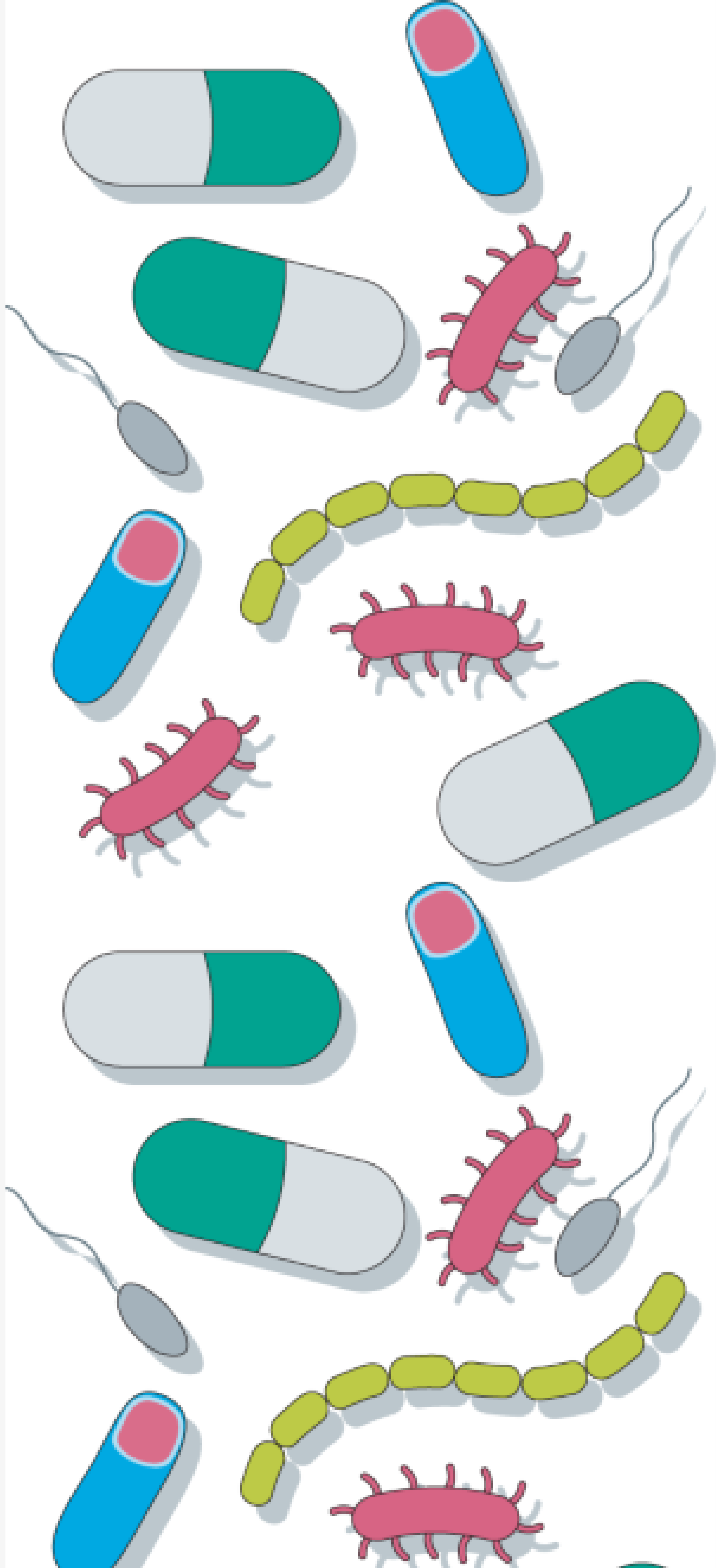


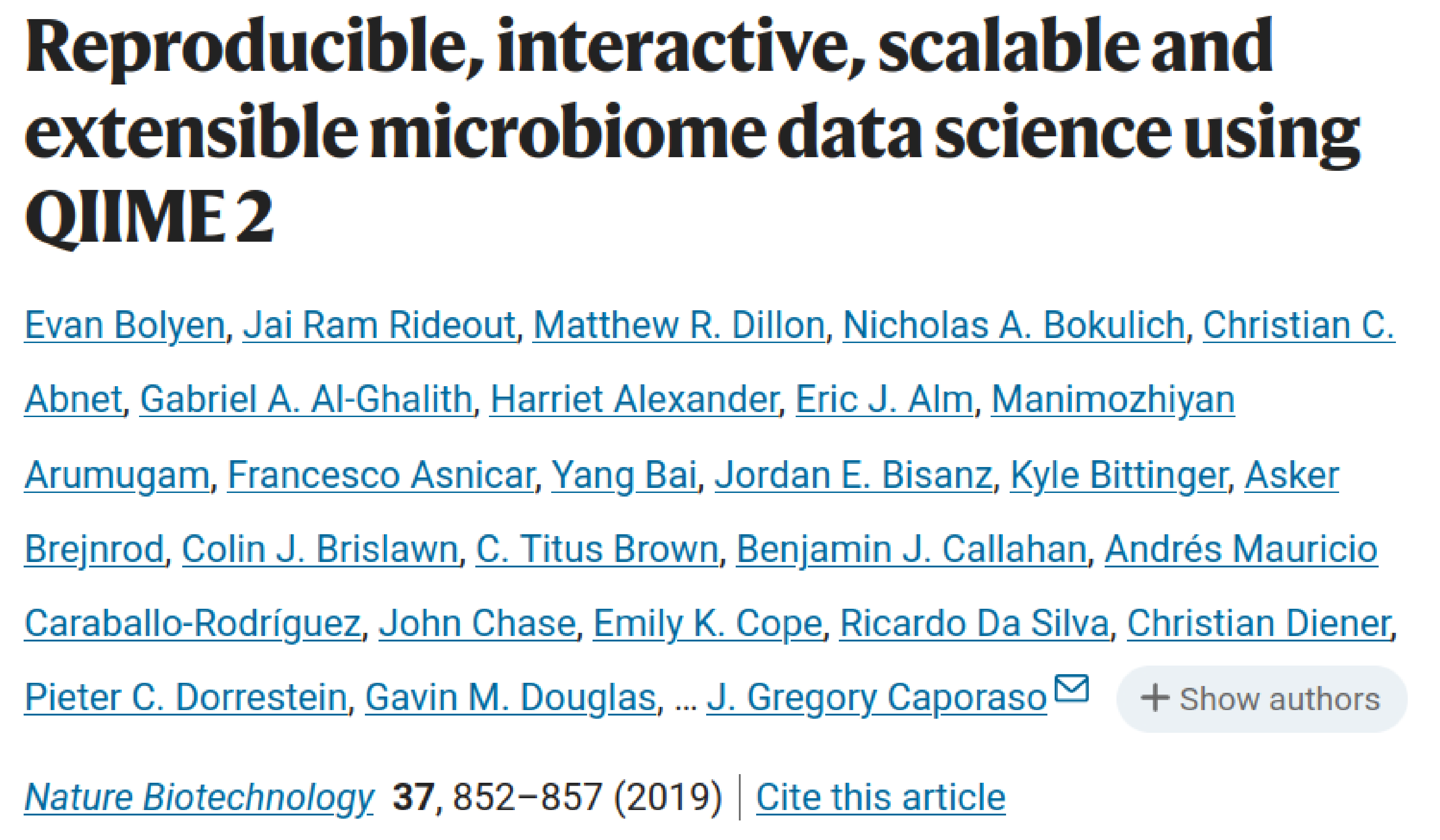
## Gut microbiome influences efficacy of PD-1–based immunotherapy against epithelial tumors

BERTRAND ROUTY, EMMANUELLE LE CHATELIER, LISA DEROSA, CONNIE P. M. DUONG, MARYAM TIDJANI ALOU, ROMAIN DAILLÈRE, AURÉLIE FLUCKIGER, MERIEM MESSAOUDENE, CONRAD RAUBER, [...], AND LAURENCE ZITVOGEL

### Good bacteria help fight cancer

Resident gut bacteria can affect patient responses to cancer immunotherapy (see the Perspective by Jobin). Routy *et al.* show that antibiotic consumption is associated with poor response to immunotherapeutic PD-1 blockade. They profiled samples from

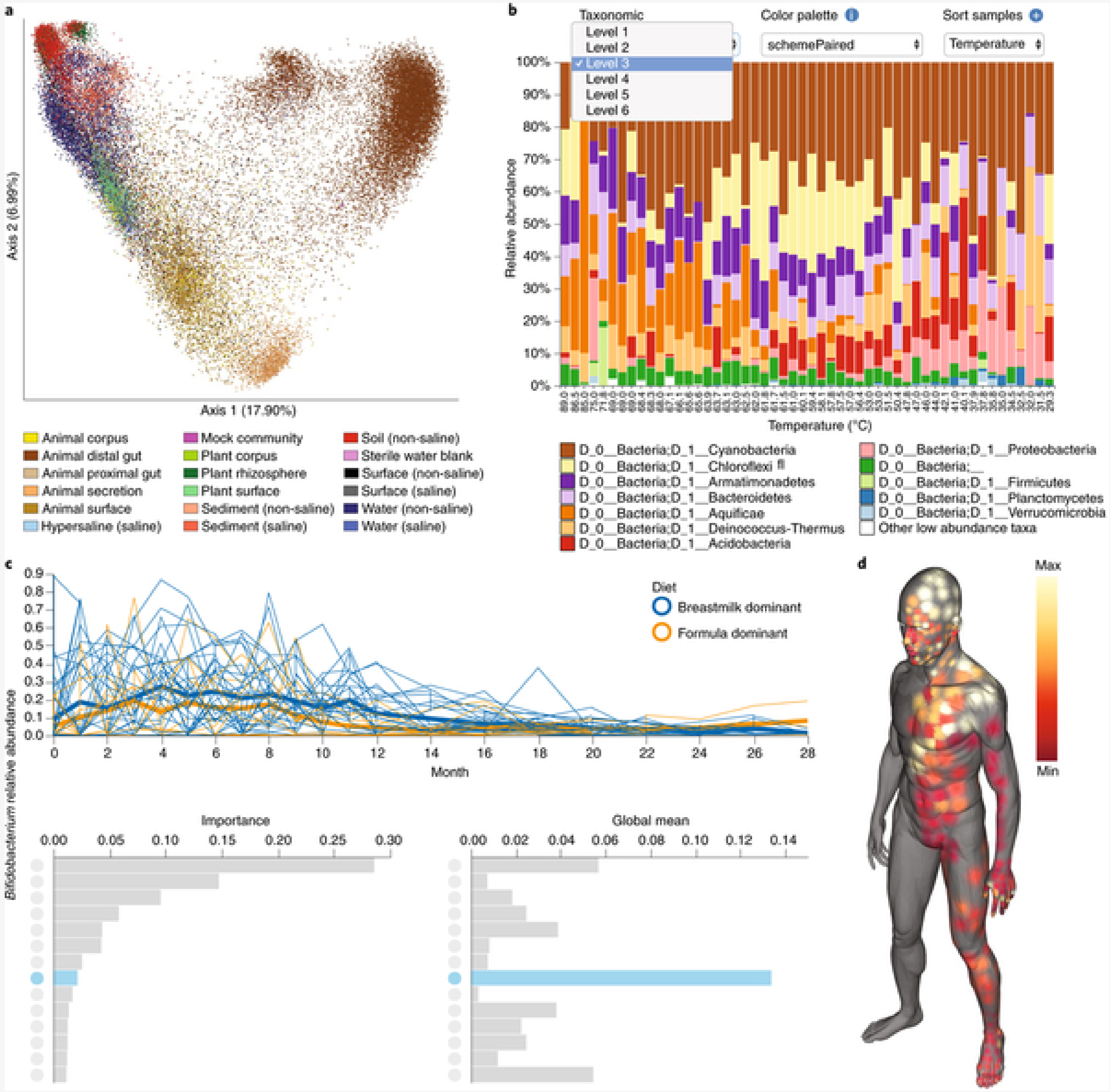




# Reproducible, interactive, scalable and extensible microbiome data science using QIIME 2

Evan Bolyen, Jai Ram Rideout, Matthew R. Dillon, Nicholas A. Bokulich, Christian C. Abnet, Gabriel A. Al-Ghalith, Harriet Alexander, Eric J. Alm, Manimozhiyan Arumugam, Francesco Asnicar, Yang Bai, Jordan E. Bisanz, Kyle Bittinger, Asker Brejnrod, Colin J. Brislawn, C. Titus Brown, Benjamin J. Callahan, Andrés Mauricio Caraballo-Rodríguez, John Chase, Emily K. Cope, Ricardo Da Silva, Christian Diener, Pieter C. Dorrestein, Gavin M. Douglas, ... J. Gregory Caporaso ✉ + Show authors

*Nature Biotechnology* **37**, 852–857 (2019) | Cite this article



doi: 10.1038/s41587-019-0209-9

# QIIME2 is completly free and Open Source

Users have a licensed right to use, redistribute and even modify QIIME2

Users can audit every line of code

World-wide network of collaborators

**https://github.com/qiime2**

# Features that attract users to system

**Latest microbiome bioinformatics methods and visualizations**

**Accessibility through detailed documentation and well-design interface**

**A community of microbiome scientists, developers and bioinformaticians**

You can share results with your team, even those members without QIIME 2 installed.

QIIME2 provides several interfaces for interacting with its platform and performing microbiome analysis.

# Core concepts

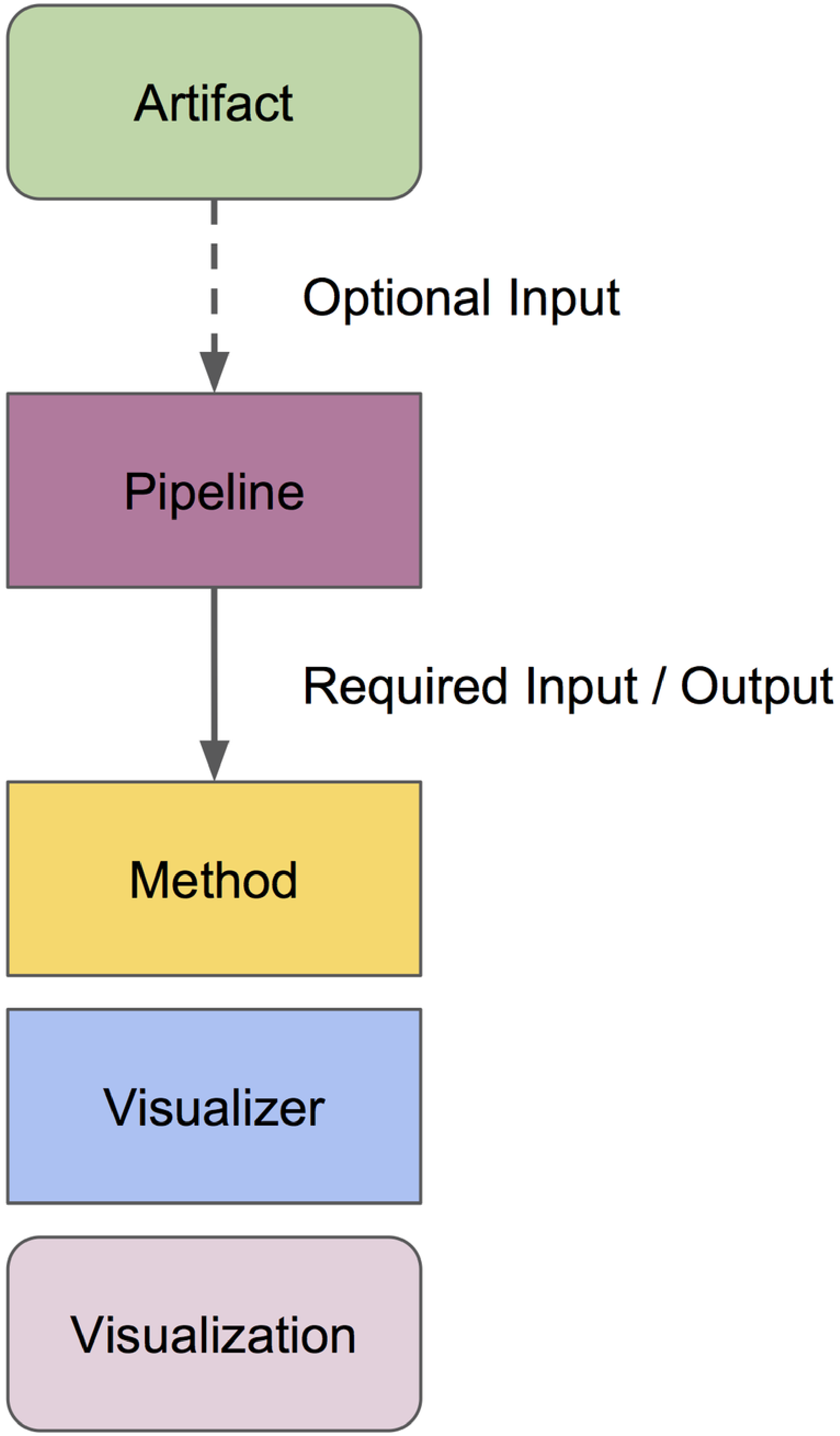
- **QIIME 2 artifacts** as .qza files

- **Visualizations** as .qzv files:
  - statistical results table
  - interactive visualization
  - static images
  - any combination of visual data representations

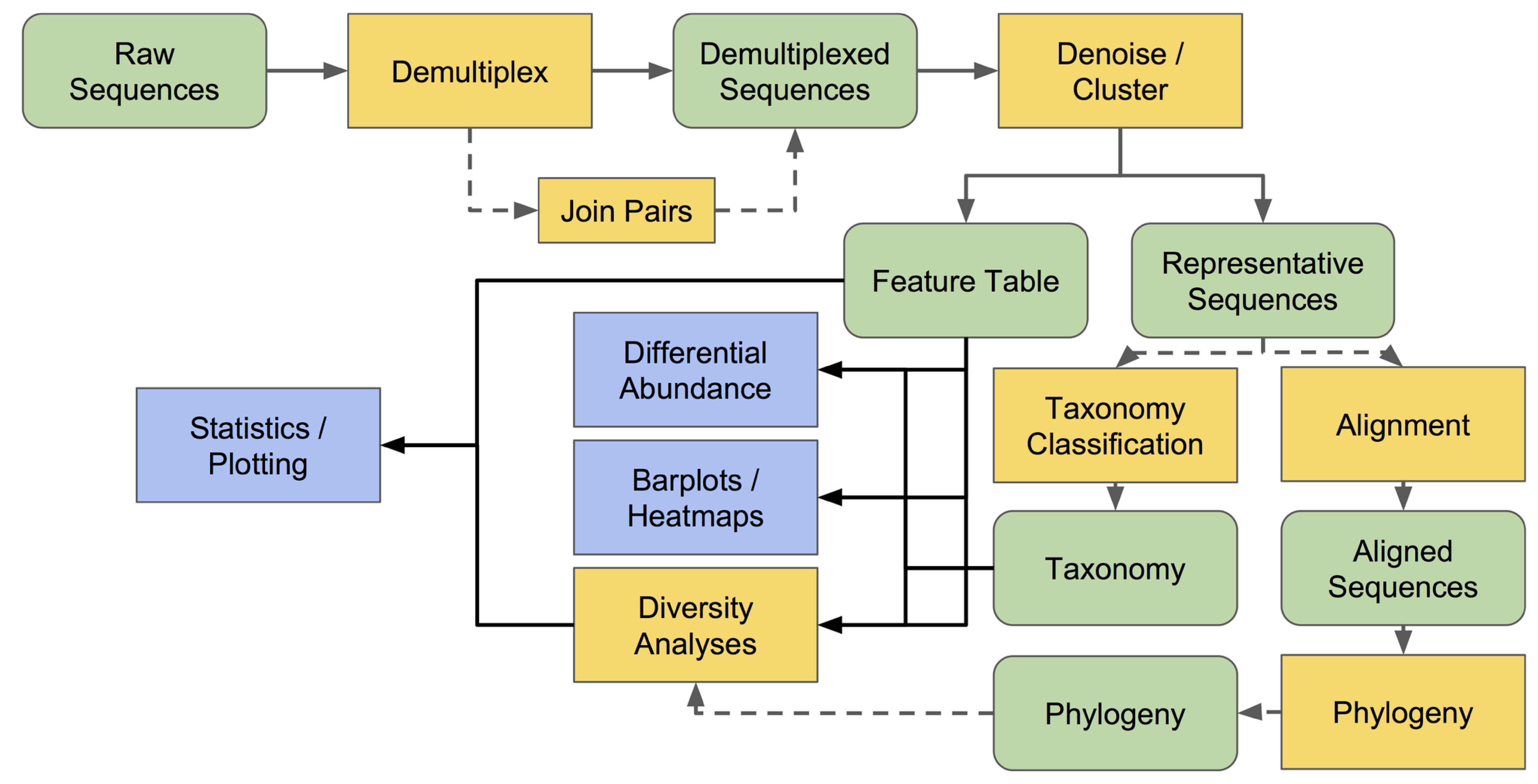
- **Semantic type**

- **Plugins**

- **Methods and visualizers**



# Amplicon sequence data analyses



# Sequence quality control and feature table construction

- **DADA2** - pipeline for detecting and correcting (where possible) Illumina amplicon sequence data
- **Deblur** - uses sequence error profiles to associate erroneous sequence reads with the true biological sequence from which they are derived
- **basic quality-score-based filtering**

Result: FeatureTable[Frequency]
FeatureData[Sequence]

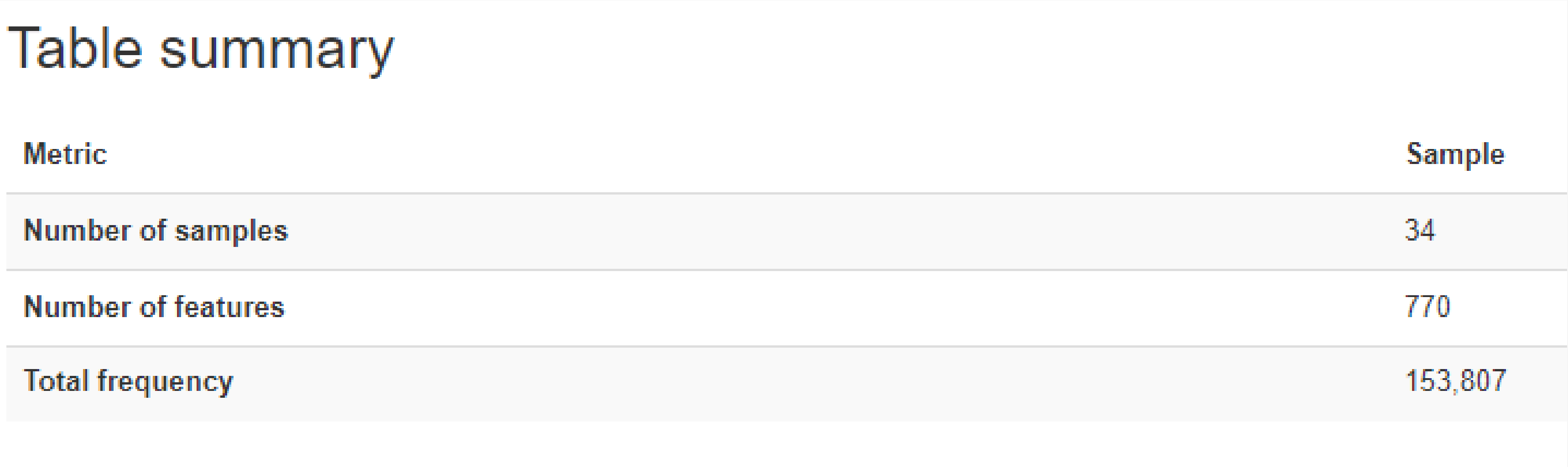
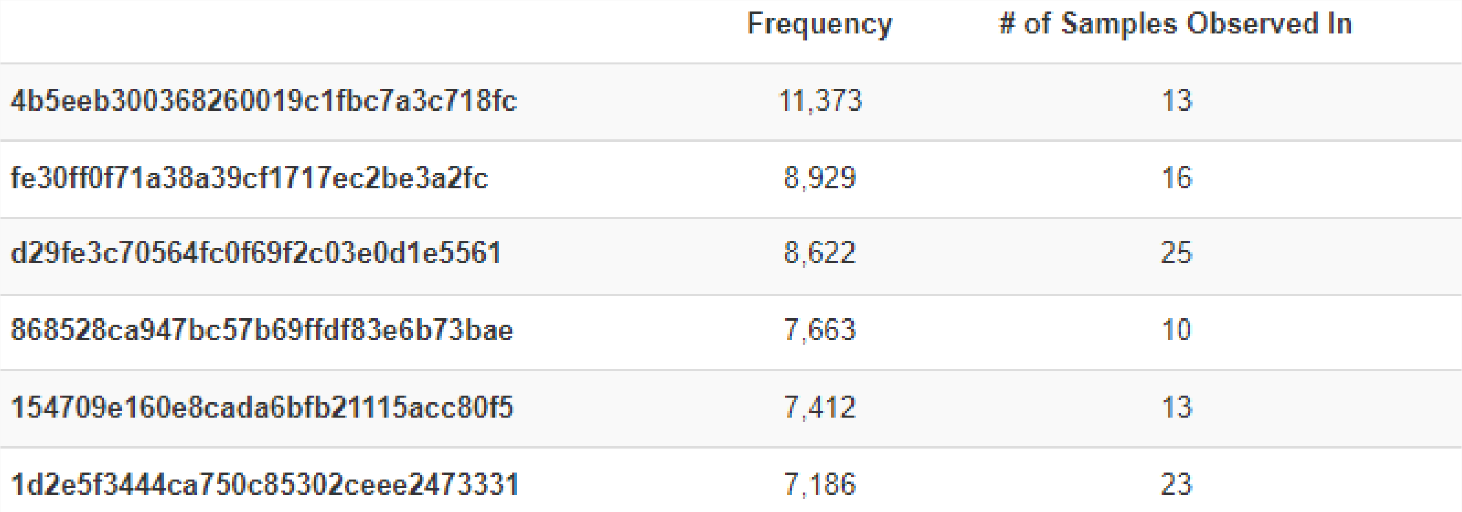
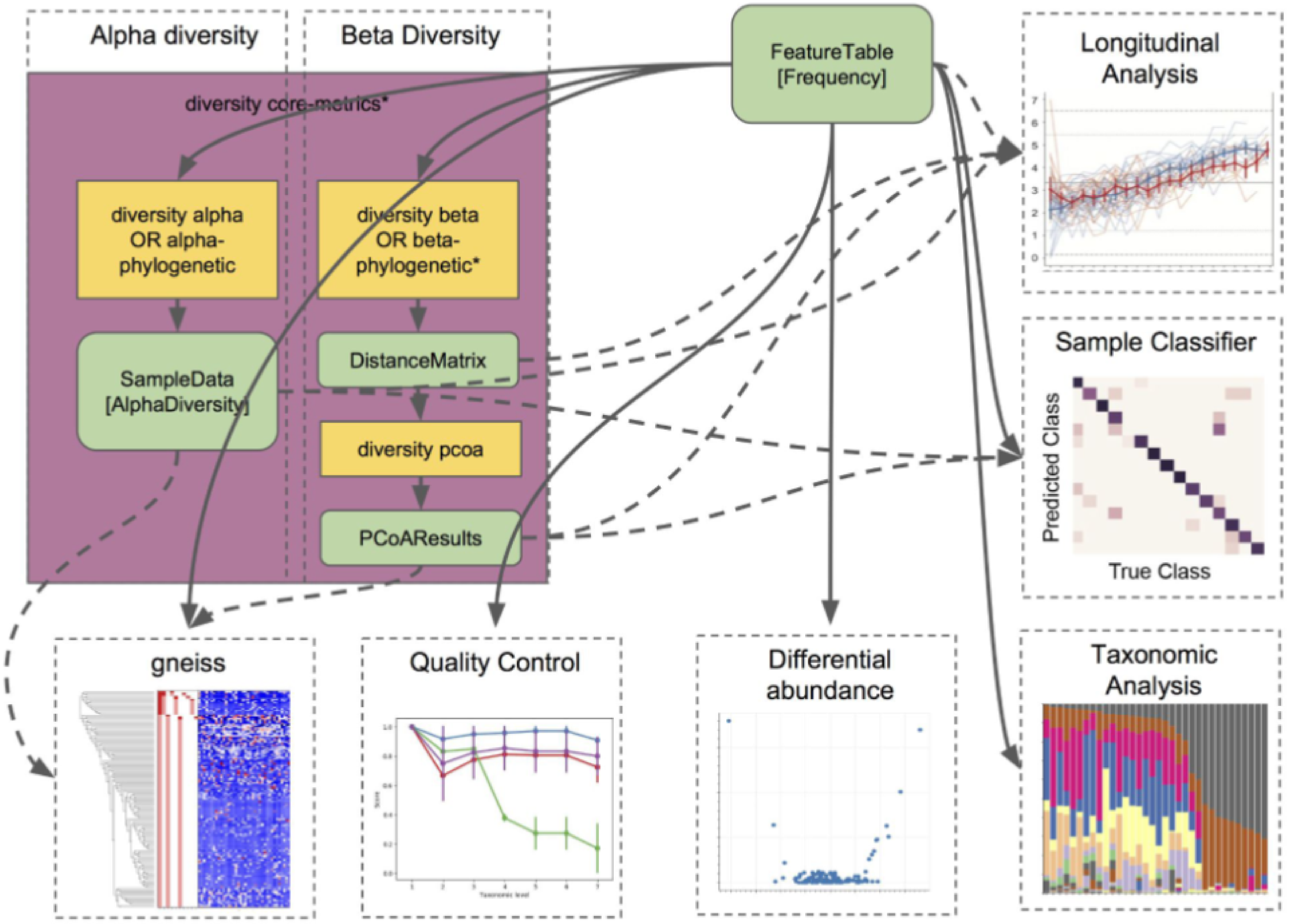


Table summary

| Metric | Sample |
|---|---|
| **Number of samples** | 34 |
| **Number of features** | 770 |
| **Total frequency** | 153,807 |



|  | Frequency | # of Samples Observed In |
|---|---|---|
| 4b5eeb300368260019c1fbc7a3c718fc | 11,373 | 13 |
| fe30ff0f71a38a39cf1717ec2be3a2fc | 8,929 | 16 |
| d29fe3c70564fc0f69f2c03e0d1e5561 | 8,622 | 25 |
| 868528ca947bc57b69ffdf83e6b73bae | 7,663 | 10 |
| 154709e160e8cada6bfb21115acc80f5 | 7,412 | 13 |
| 1d2e5f3444ca750c85302ceee2473331 | 7,186 | 23 |



Alpha diversity

Beta Diversity

FeatureTable
[Frequency]

diversity core-metrics*

diversity alpha
OR alpha-
phylogenetic

diversity beta
OR beta-
phylogenetic*

SampleData
[AlphaDiversity]

DistanceMatrix

diversity pcoa

PCoAResults

Longitudinal
Analysis

Sample Classifier

Taxonomic
Analysis

gneiss

Quality Control

Differential
abundance

# Tutorials

https://docs.qiime2.org/2024.2/tutorials/

- “Moving pictures”
- ‘Fecal microbiota transplant”
- “Atacama soil microbiome”
- “Parkinson’s mouse”

..and thank for your attention