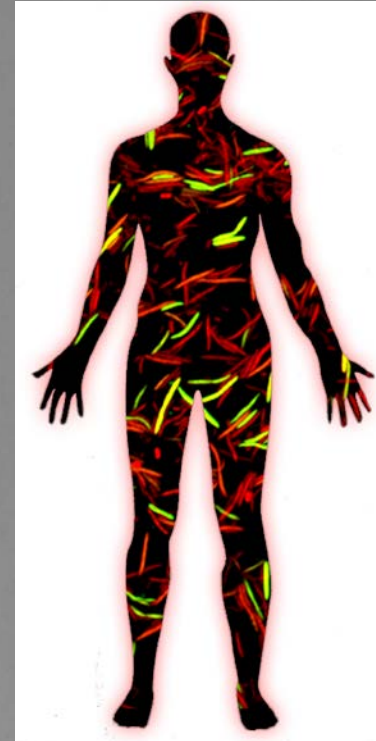


Microbiome research



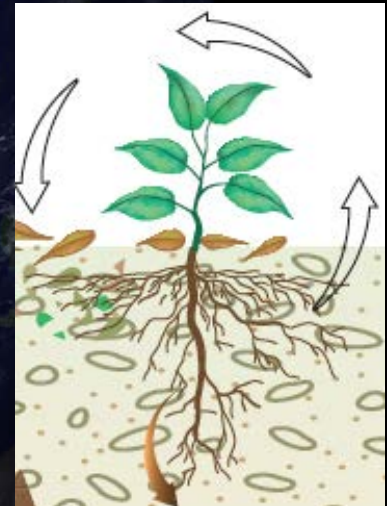
Prof. Dr. Tim Urich
Department of Bacterial Physiology
Institute of Microbiology
EMAU Greifswald

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Earth: a microbial planet



Human microbiome



Plant microbiome

Man and Microbes = a Superorganism



- **100 trillion** (10^{14}) microbes in the intestinal tract
- Colon: 10^{11} - 10^{12} cells/ml
- Microbiome **>100 times more genes** than human genome
- Gut microbiome: “the forgotten organ”
- Microbes as **beneficial commensals**:
 - Immune stimulation/modulation
 - Protection against pathogens
 - Digestion/provision of nutrients
(e.g. vitamins, fiber breakdown, SCFAs)
- Role in obesity, IBD, cardiovascular disease, etc... Dysbiosis
- **Methanogens** minor component, up to 10% in colon
- ensure efficient anaerobic degradation

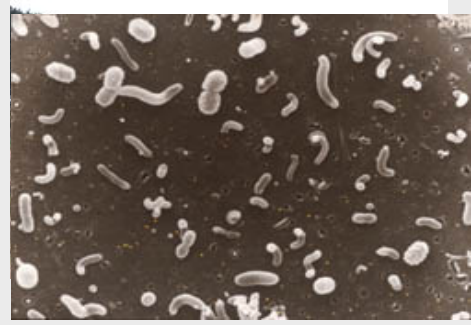


Research interests / projects

- GIT microbiota of humans and animals – role in health / disease / GHG emissions
- Microbes in (permafrost) soils and their role in global GHG emissions
- Interactions (metabolic and trophic) between microorganisms and their consequences for ecosystem functioning
- Methanogenic archaea: physiology and ecology of novel methanogens
- Infant gut microbiome in zoonotic helminth infections (anemia, morbidity)

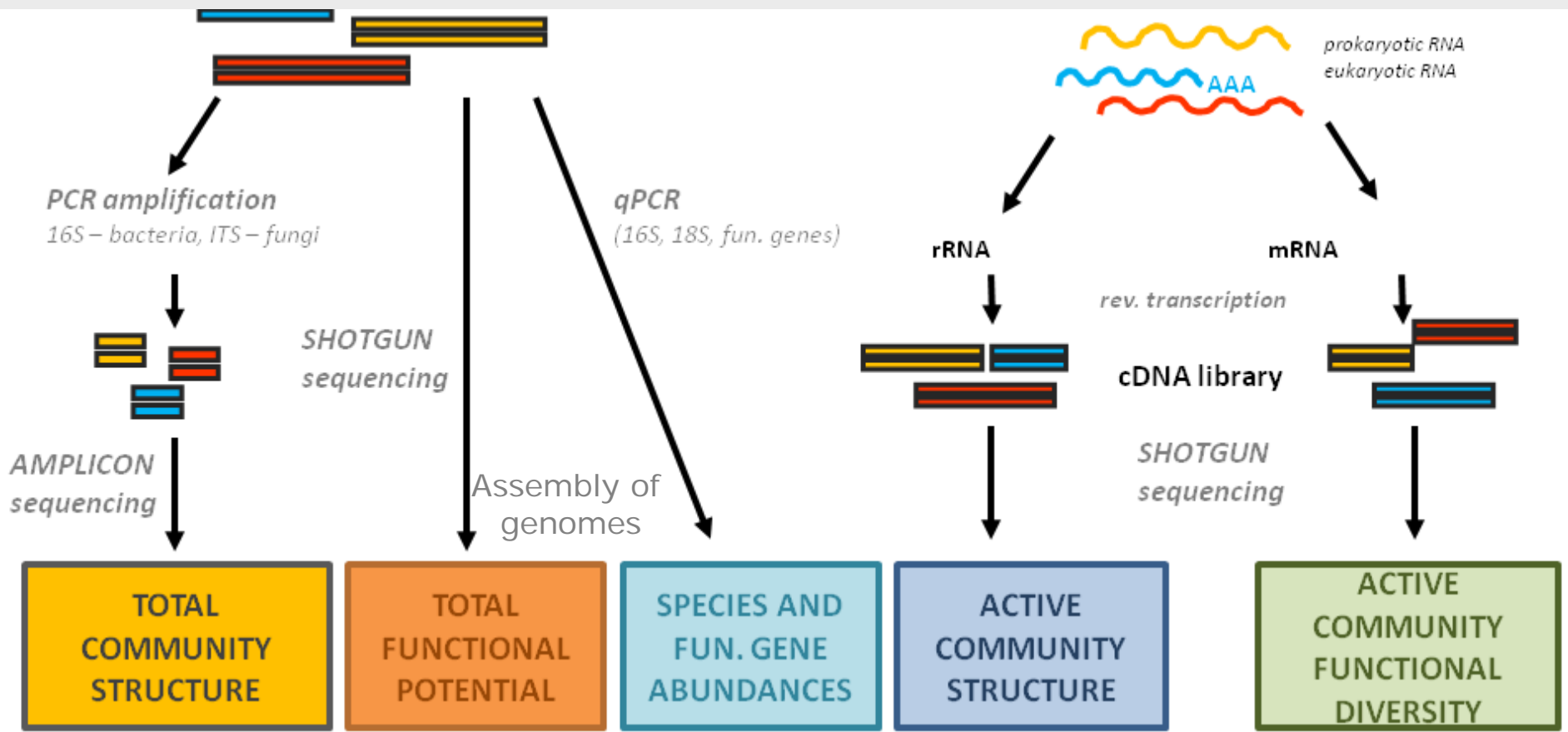
(functional) Metagenomics to assess the uncultured majority

Leininger et al., 2006
Urich et al., 2008



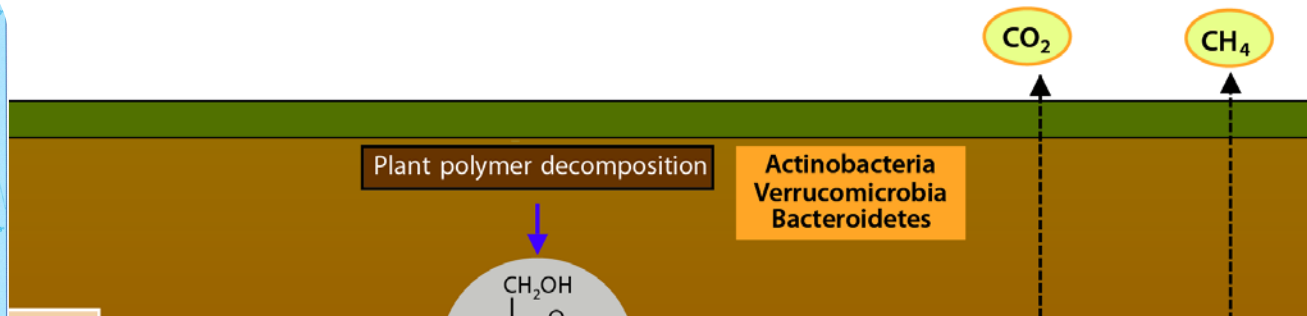
Metagenomics
'present' **DNA**

Metatranscriptomics
RNA 'active'



Integrate with complementary approaches

Anaerobic C mineralisation in arctic peat soils: key role of methanogens for GHG production

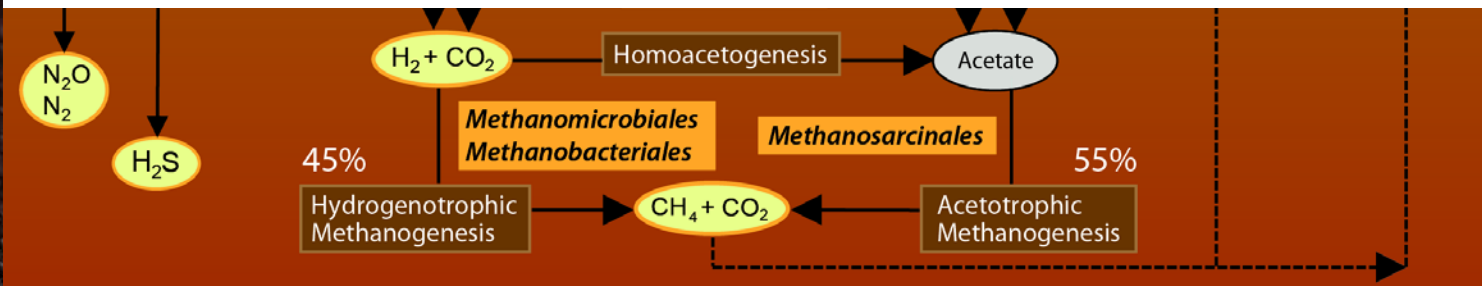


Metabolic and trophic interactions modulate methane production by Arctic peat microbiota in response to warming

Alexander Tøsdal Tveit^{a,1}, Tim Urich^{b,c}, Peter Frenzel^d, and Mette Marianne Svenning^{a,1}

^aDepartment of Arctic and Marine Biology, University of Tromsø The Arctic University of Norway, 9037 Tromsø, Norway; ^bDepartment of Ecogenomics and Systems Biology, University of Vienna, 1090 Vienna, Austria; ^cAustrian Polar Research Institute, 1090, Vienna, Austria; and ^dDepartment of Biochemistry, Max Planck Institute for Terrestrial Microbiology, 35043 Marburg, Germany

Edited by Edward F. DeLong, University of Hawaii, Manoa, Honolulu, HI, and approved April 6, 2015 (received for review October 31, 2014)



Integrated metatranscriptomics, metagenomics and metabolomics

ORIGINAL ARTICLE

Longitudinal study of murine microbiota activity and interactions with the host during acute inflammation and recovery

Clarissa Schwab¹, David Berry², Isabella Rauch³, Ina Rennisch¹, Julia Ramesmayer², Eva Hainzl⁴, Susanne Heider⁵, Thomas Decker³, Lukas Kenner⁵, Mathias Müller⁴, Birgit Strobl⁴, Michael Wagner², Christa Schleper¹, Alexander Loy² and Tim Urich¹



IBD

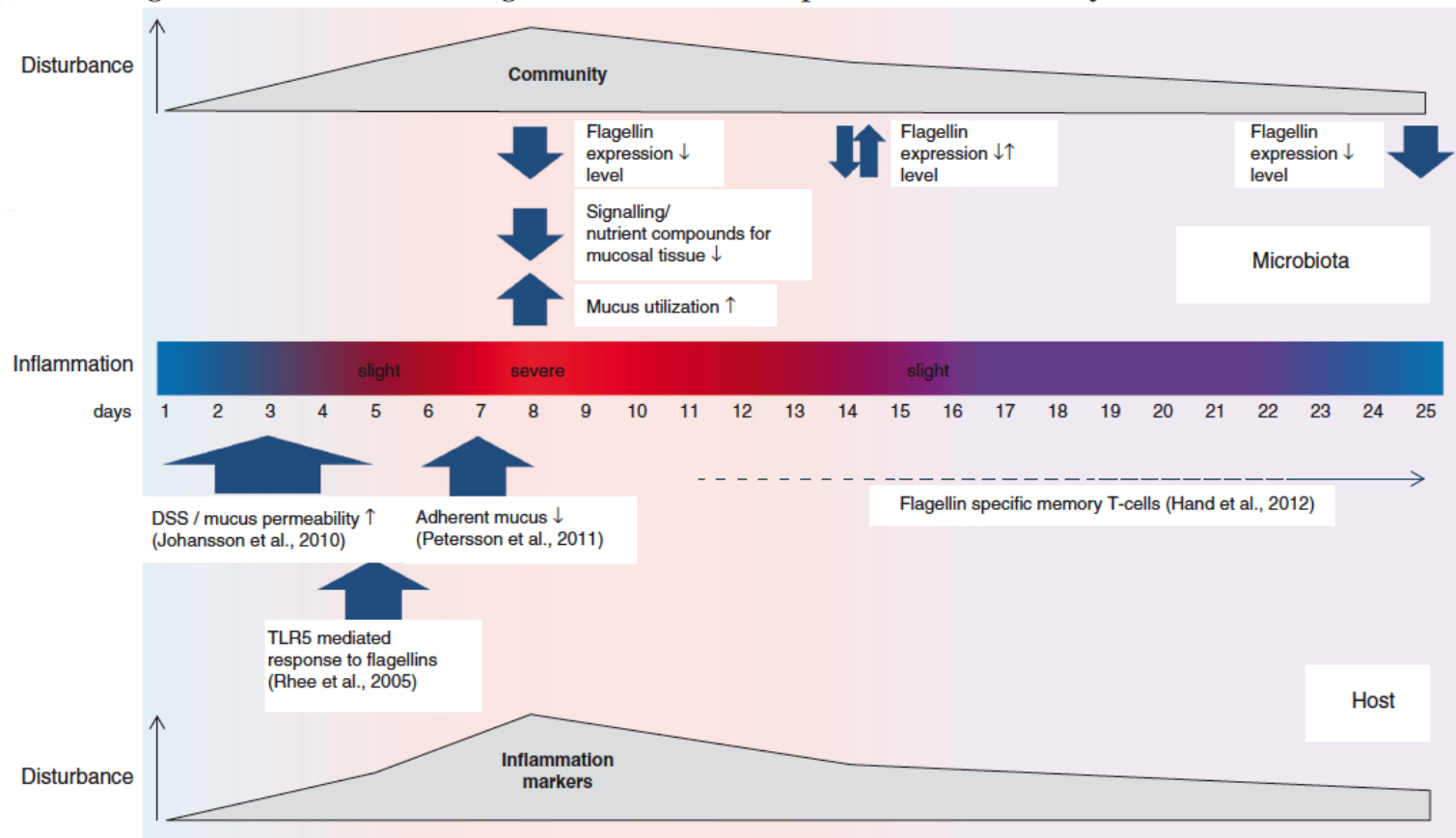
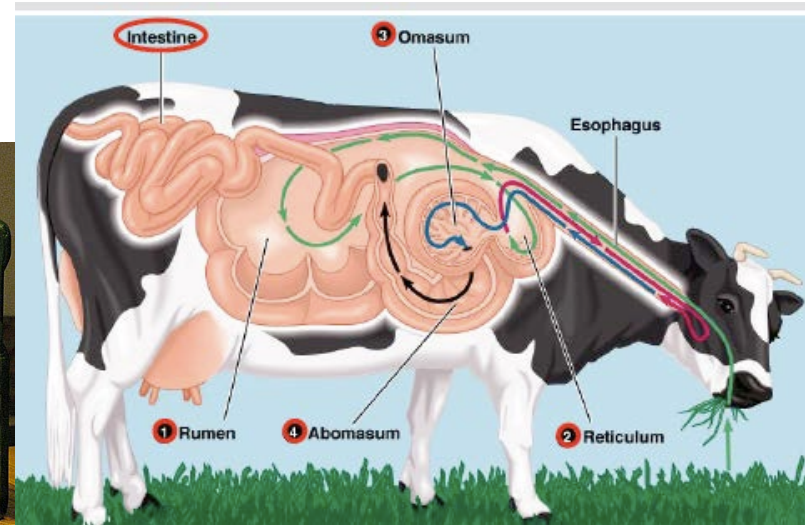


Figure 8 Timeline of the interplay of host and microbiota during colitis and recovery.

Methylothermic methanogenic Thermoplasmata implicated in reduced methane emissions from bovine rumen

Morten Poulsen¹, Clarissa Schwab², Bent Borg Jensen¹, Ricarda M. Engberg¹, Anja Spang², Nuria Canibe¹, Ole Højberg¹, Gabriel Milinovich², Lena Fragner³, Christa Schleper², Wolfram Weckwerth³, Peter Lund¹, Andreas Schramm⁴ & Tim Urich²

- New order of methanogenic archaea: *Methanomassiliicoccales*
- Methylated amines (e.g. TMA) as electron acceptors
- reduced abundance when rape seed oil applied as methane mitigation strategy
- ca. 20% less methane / L milk



Central role of TMA in human cardiovascular disease

Trimethylamine (TMA)

- Tang et al., N Engl J Med 2013; Tremaroli & Bäckhed, Nature 2012 and others:
- Gut microbiota catalyzes TMA formation from choline and carnitine
- Until very recently no microorganisms known to degrade TMA in human gut!
- MMC present in humans!
- Age-related prevalence of MMC
- Usage as Probiotic for TMA degradation? (Morrison 2013, Brugere et al., 2014)

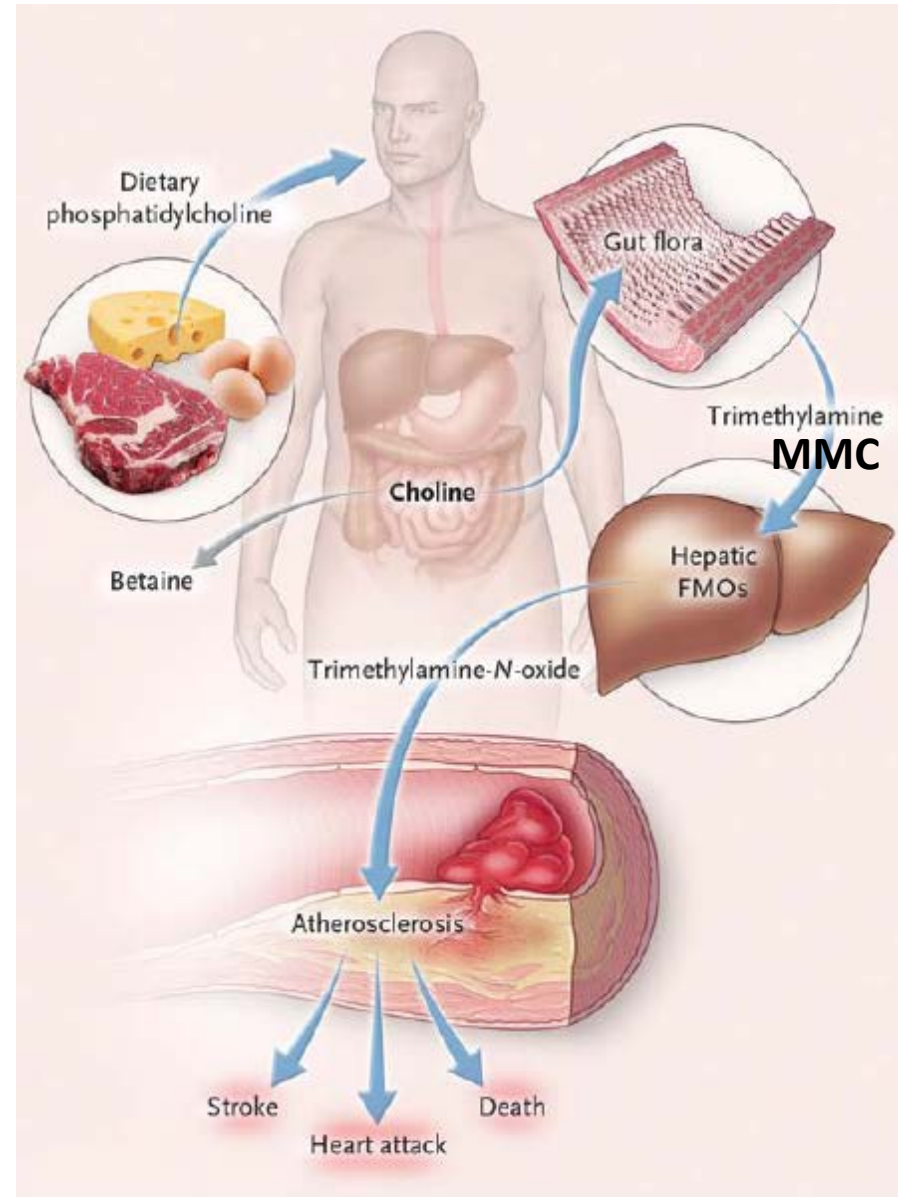
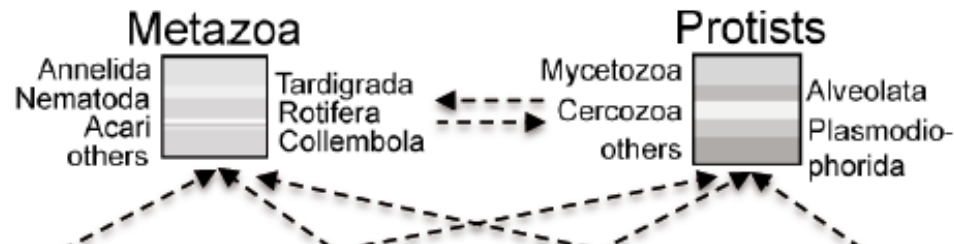


Figure 3. Pathways Linking Dietary Phosphatidylcholine, Intestinal Microbiota, and Incident Adverse Cardiovascular Events.

Ribo-tag vs. 16S rRNA amplicon



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www.nature.com/ismej

ORIGINAL ARTICLE

Metatranscriptomic census of active protists in soils

Stefan Geisen^{1,2}, Alexander T Tveit³, Ian M Clark⁴, Andreas Richter⁵, Mette M Svenning³, Michael Bonkowski¹ and Tim Urich⁶

3-Domain community profile
ribosomal RNA

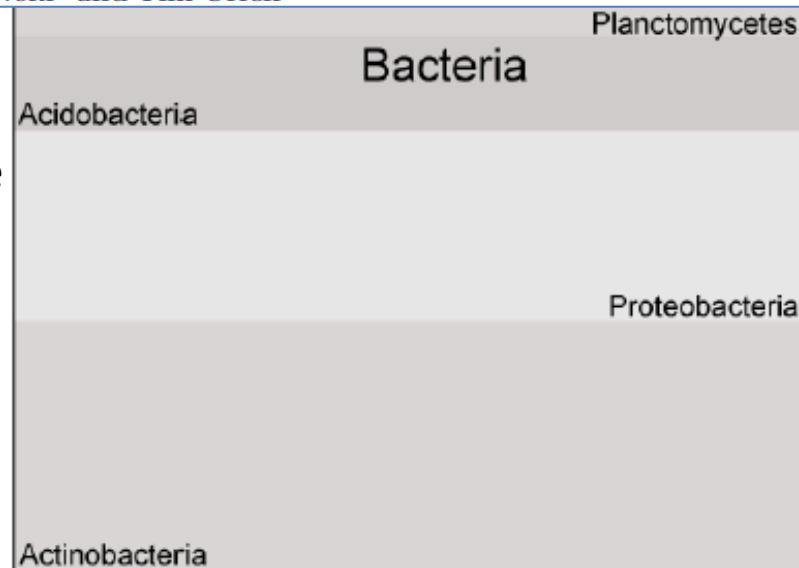
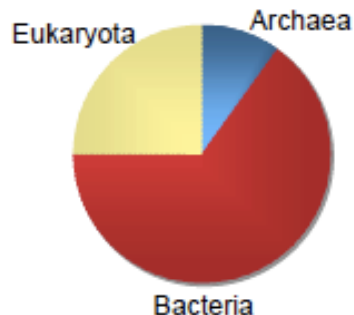
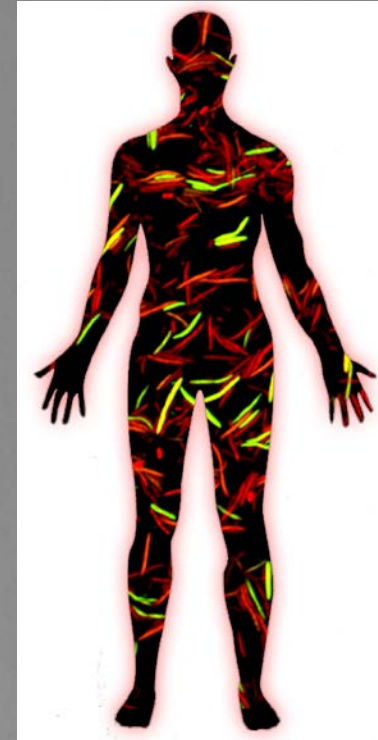


Figure 2: A holistic view onto the soil (microbial) community from an SSU rRNA perspective.

Microbiome research



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