The ecology of the human microbiome in health and disease.

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everything is an ecosystem
more numerous than the stars

$\sim 1 \times 10^{23}$ stars in the observable universe

$\sim 5 \times 10^{30}$ microbes on Planet Earth
ancient forebears of life

YOU, circa now

LUCA, circa 3.8 Gy ago
small, yet mighty
holobionts

http://www.bosch.zoologie.uni-kiel.de/wp-content/uploads/2013/05/microbiota.jpg
seeing the invisible
seeing the invisible
seeing the invisible
the human microbiome
since the dawn of humankind

Ochman et al. 2010, PLOS Biology
a broken contract?

http://missinghumanmanual.com/?p=777
a broken contract?
a broken contract?
the hygiene hypothesis

Dirt is good for you?
The Center’s mission is to streamline discovery of diagnostics and treatments for microbiome-associated disease by serving as the hub of clinically-relevant human microbiome research and engineering.
repoopulation saves lives!
targeted microbial therapeutics
designing persistent probiotics

Bifidobacterium longum persists when its niche is vacant
**synbiotics** (prebiotic + probiotic)

**LETTERS**

**Transfer of carbohydrate-active enzymes from marine bacteria to Japanese gut microbiota**

Jan-Hendrik Hehemann$^{1,2,\dagger}$, Gaëlle Correc$^{1,2}$, Tristan Barbeyron$^{1,2}$, William Helbert$^{1,2}$, Mirjam Czjzek$^{1,2}$ & Gurvan Michel$^{1,2}$

*Zobellia galactanivorans*

*Bacteroides plebeius*
**synbiotics (prebiotic + probiotic)**

**Experimental Design**

(aka feeding mice sushi nori)

- **No seaweed**
- **Seaweed pulsed** (4 day periods)
- **Seaweed constant**

**Bacteroides plebeius**
FINCH THERAPEUTICS

(a) Healthy mouse → Passages of fecal material → Mouse infected with *C. difficile* → Treat with different passages of fecal material. Identify passage that cures infection. → Cultured species from curative passage → Mouse infected with *C. difficile* → Treat with a set of defined species → Disease is cured

(b) Healthy human → Healthy strain collection → Select strain collection to treat disease → Diseased human → Diseased state → Healthy state → Community state landscape → Targeted therapeutics → Disease is cured

http://www.nature.com/nbt/journal/v31/n1/fig_tab/nbt.2475_F1.html
Vanessa Leone Eugene Chang

Alan Hutchison

“The microbiome and the midnight snack: How gut microbes influence the body’s clock”
–Matt Wood, Science Life Blog at UChicago

microbes help regulate their host
the built environment

Photo credit: A detailed analysis of the microbes that live in houses and apartments shed light on the complicated interaction between humans and the microbes that live on and around us / Argonne National Laboratory
our microbial aura

This animation was created by the Biology and the Built Environment (BioBE) Center with Cameron Slayden (Cosmocyte) and funded by the Alfred P. Sloan Foundation.
the hospital microbiome project

http://hospitalmicrobiome.com/

The Crimean War Hypothesis: Are hospitals too sterile??
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Thanks to you for your attention!
zen and the art of microbe maintenance

http://mag.uchicago.edu/science-medicine/microbial-me
Ecological Succession and Viability of Human-Associated Microbiota on Restroom Surfaces

Beware of Headlines!!
Longitudinal analysis of microbial interaction between humans and the indoor environment

Simon Lax

Dan Smith

Jack Gilbert