

Gut and Immune System

Getting By With A Little Help From Our Friends? The Gut Microbiome In Health And Disease



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Annals of Science

Germs Are Us

Bacteria make us sick. Do they also keep us alive?

by [Michael Specter](#) October 22, 2012



By the time a child crawls, he is blanketed by an enormous cloud of microorganisms.



A few basics

Definition of the Microbiota

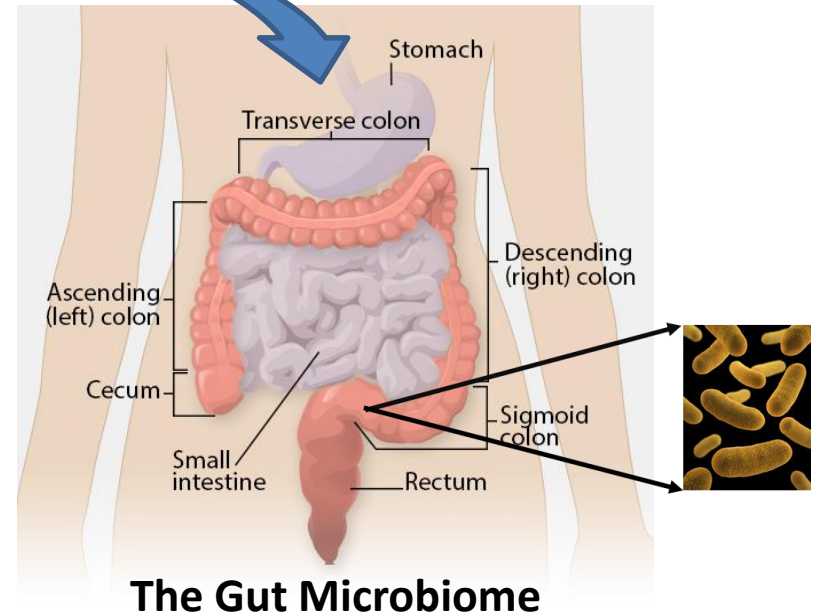
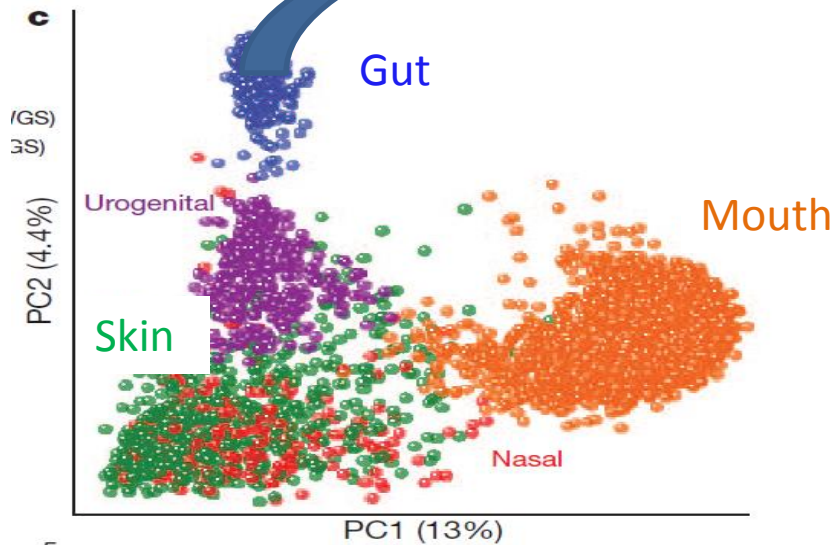
All the microbes (trillions!) we share our bodies with

Bacteria > Other organisms (e.g. Viruses, Fungi)

We are at least as much “bacteria” as we are human!

The Make-up of the Human Microbiome

We each differ!



>**Key Concept:** Different body sites develop **distinct microbiomes** to promote the function of that tissue

Gut microbiome: over 1000 species

https://www.cdc.gov/cancer/colorectal/images/colon_illustration_lg.jpg

<https://phil.cdc.gov/phil/details.asp>

Nature 449:811, 2007

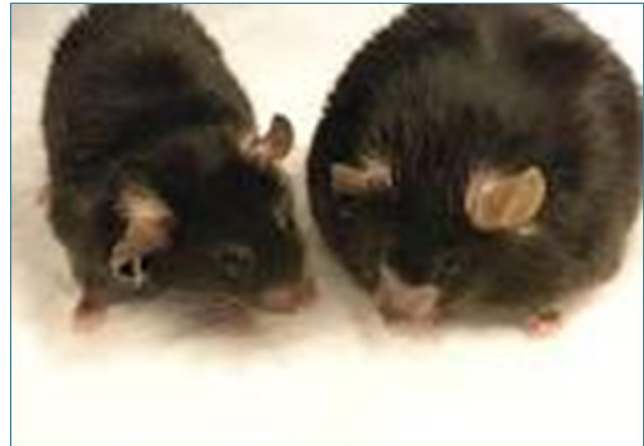


Gut Microbiota from Twins Discordant for Obesity Modulate Metabolism in Mice
Vanessa K. Ridaura *et al.*
Science 341, (2013);
DOI: 10.1126/science.1241214

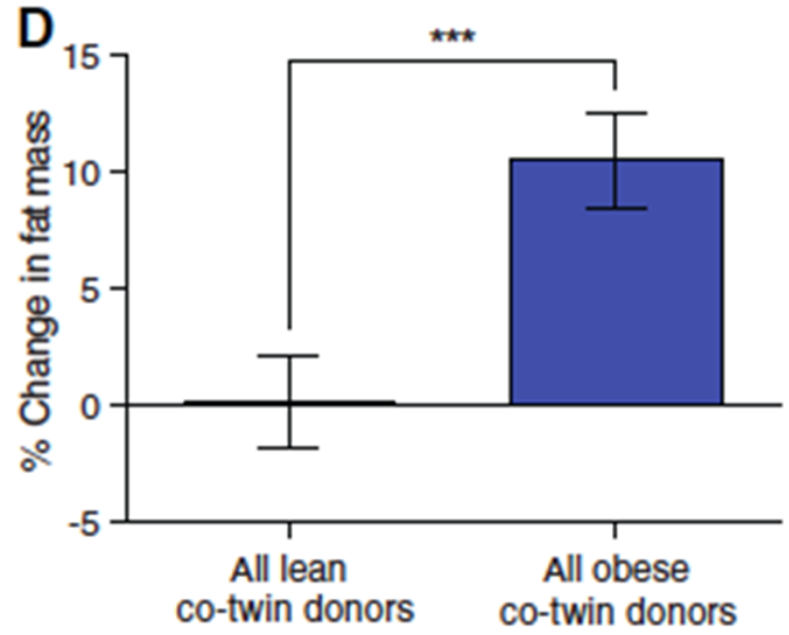
1930's: Germ Free Mouse + Microbiota → Rapid weight gain

Fecal transplant

Nutritional Impact



Obesity can be a microbiota transmissible trait



The Gut Microbiome in Health

1. The gut microbiome helps us to digest food.
2. The gut microbiome helps prevent colonization and overgrowth of pathogens (bad bugs).
3. **The gut microbiome is likely essential to normal the immune system.**

The Gut Microbiome and the Healthy Immune System

TLR5-Mediated Sensing of Gut Microbiota Is Necessary for Antibody Responses to Seasonal Influenza Vaccination

Immunity
Article
2014

Jason Z. Oh,^{1,2} Rajesh Ravindran,^{1,2} Benoit Chassaing,⁴ Frederic A. Carvalho,^{4,5} Mohan S. Maddur,^{1,2} Maureen Bower,⁶ Paul Hakimpour,² Kiran P. Gill,^{1,2} Helder I. Nakaya,^{3,7} Felix Yarovinsky,⁸ R. Balfour Sartor,⁸ Andrew T. Gewirtz,⁴ and Bali Pulendran^{1,2,3,*}

Germ Free Mouse + Flu Vaccine → Few Antibodies

Germ Free Mouse + Microbiota + Flu Vaccine → More Antibodies



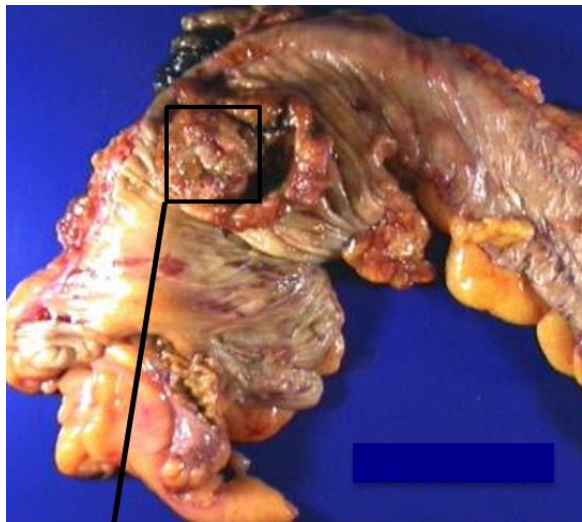
The Gut Microbiome in Disease?

Microbiota organization is a distinct feature of proximal colorectal cancers



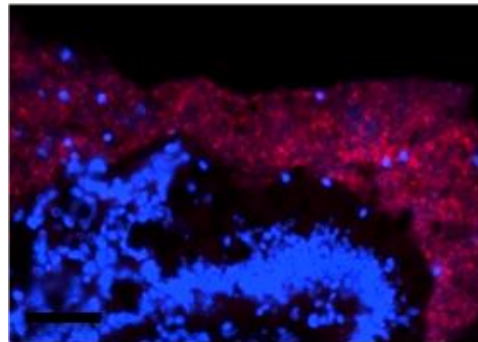
Christine M. Dejea^a, Elizabeth C. Wick^b, Elizabeth M. Hechenbleikner^b, James R. White^{c,1}, Jessica L. Mark Welch^d, Blair J. Rossetti^d, Scott N. Peterson^{e,2}, Erik C. Snestrud^{e,3}, Gary G. Borisy^d, Mark Lazarev^f, Ellen Stein^f, Jamuna Vadivelu^g, April C. Roslani^h, Ausuma A. Malik^h, Jane W. Wanyiri^f, Khean L. Gohⁱ, Iyadorai Thevambiga^g, Kai Fu^j, Fengyi Wan^{j,k}, Nicolas Llosa^l, Franck Housseau^k, Katharine Romans^{m,n}, XinQun Wu^f, Florencia M. McAllister^k, Shaoguang Wu^f, Bert Vogelstein^{m,n}, Kenneth W. Kinzler^{m,n}, Drew M. Pardoll^{f,k}, and Cynthia L. Sears^{a,f,k,4}

PNAS | December 23, 2014 | vol. 111 | no. 51 | 18321–18326

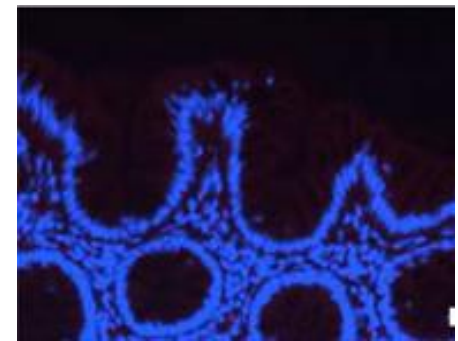


Colon cancer

Tumor



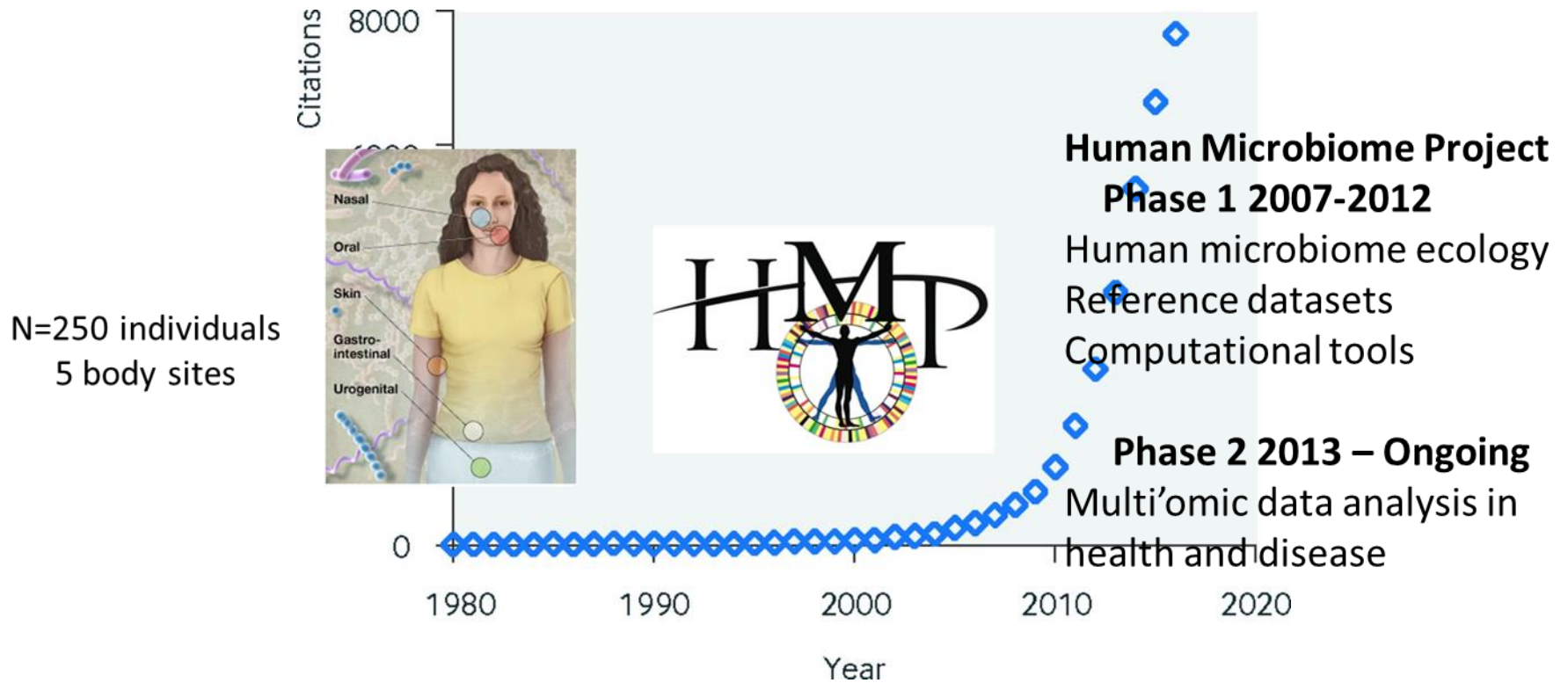
Normal pt:
No Tumor



Future Directions?

- **Will microbiota studies inform our approach to prevention of disease?**
 - The microbiota may be critical to vaccine responses (Oh et al. Immunity 2014)
 - The microbiota may impact how plaque develops in our blood vessels → heart attacks, strokes (Tong et al. NEJM 2013, Wang et al. Cell 2015)
- **Will specific bacteria or communities help us improve our treatments for diseases e.g. cancer?**
 - In mice, specific gut bacteria may improve response to anti-cancer immunotherapy (Vetizou et al. Science 2015, Sivan et al. Science 2015)
- **Will microbiota studies help us develop individualized medicine?**
 - Gut microbiota (along with other factors) may help predict blood sugar responses to certain foods on an individual level (Zeevi et al. Cell 2015)
- **Can new sequencing technologies and the microbiota help us to diagnose and prognosticate disease?**
 - Wilson et al. NEJM 2014, **Salzberg et al. Neurology 2016**

Microbiome Research



Increase in publications on the microbiome 1980-2016. Young et al. BMJ 2017

Thank you!

Questions?